PACIFIC NORTHWEST SEISMIC HAZARDS: PLANNING AND PREPARING FOR THE NEXT DISASTER

(114–18)

HEARING

BEFORE THE

SUBCOMMITTEE ON
ECONOMIC DEVELOPMENT, PUBLIC BUILDINGS, AND
EMERGENCY MANAGEMENT

OF THE

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TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

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May 15, 2015

SUMMARY OF SUBJECT MATTER

TO: Members, Committee on Transportation and Infrastructure
FROM: Staff, Subcommittee on Economic Development, Public Buildings, and Emergency Management
RE: Committee Hearing on "Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster."

PURPOSE

The Subcommittee on Economic Development, Public Buildings, and Emergency Management will hold a hearing on Tuesday, May 19, 2015, at 10:00 a.m. in 2167 Rayburn House Office Building for a hearing titled "Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster." The purpose of the hearing is: (1) to assess the Federal Emergency Management Agency's (FEMA) role in earthquake hazard preparedness, mitigation, response, and recovery; and (2) to examine the efforts of the Pacific Northwest and seismic hazard experts to reduce disaster impacts and build stronger communities. The Subcommittee will receive testimony from FEMA and leaders in engineering and seismology.

BACKGROUND

Over the last five years, globally there have been at least six catastrophic earthquakes. On May 12 and April 25, 2015, just two weeks apart, a 7.3 magnitude earthquake and a 7.8 magnitude earthquake struck Nepal. On March 11, 2011, a 9.0 magnitude earthquake jolted Honshu, Japan. In 2010, there were two powerful earthquakes within a month of each other—the January 12th earthquake in Haiti and the February 27th 8.8 magnitude earthquake in Chile. Combined, these earthquakes caused hundreds of thousands of deaths and injuries and a tremendous amount of property damage. Some caused tsunamis that washed away towns and resulted in damage in other countries. Here in the United States, the most recent devastating earthquakes were over 20 years ago in California: the October 17, 1989, Loma Prieta 6.9 earthquake, which resulted in 63 deaths and thousands of injuries and the January 17, 1994, Northridge 6.7 earthquake, which resulted in 57 deaths, more than 5,000 injured, and an estimated $20 billion in property damage.

Every state has the potential for earthquakes, and the U.S. Geological Survey estimates that "42 of the 50 states have a reasonable chance of experiencing damaging ground shaking from an earthquake in 50 years (the typical lifetime of a building)."[1] Earthquakes pose a national challenge because 75 million Americans live in areas of significant seismic risk. Unlike hurricanes, tornados, and other storms, earthquakes strike without warning and may trigger devastating secondary effects, such as landslides, fires, tsunamis, and nuclear meltdowns. The damage wrought by earthquakes has a significant impact on people, infrastructure, and the economy.

Most of the Nation's earthquake risk is concentrated on the West Coast. FEMA has estimated the average annualized loss from earthquakes, nationwide, to be $5.3 billion, with 77 percent of that figure ($4.1 billion) coming from California, Washington, and Oregon, and 66 percent ($3.5 billion) from California alone.[2] In the next 30 years, California has a 99.7 percent chance of a magnitude 6.7 or larger earthquake, and the Pacific Northwest has a 10 percent chance of a magnitude 8 to 9 megathrust earthquake on the Cascadia Subduction Zone.[3]

States in the Pacific Northwest are partnering with the federal government to increase preparedness for the next earthquake with the goal of reducing earthquake losses, damages, and overall disaster losses. There are lessons to be learned from these best practices that can be implemented across the country, but much work is still needed to establish an earthquake early warning system and to encourage smart building and mitigation measures that will ultimately drive down the costs of these disasters.

ISSUES

FEMA's Role in Earthquake Preparedness, Mitigation, Response, and Recovery

FEMA was established in 1979 as the centralized location for federal disaster assistance and coordination of the federal government's disaster activities. FEMA is the federal government's lead agency for preparing for, mitigating, responding to, and recovering from disasters and emergencies related to all hazards, whether natural or man-made.

The Post Katrina Emergency Management Reform Act (P.L. 109-295) requires FEMA to perform national level exercises to test and evaluate federal, state, local, and tribal governments' ability to respond and recover in a coordinated and unified manner to catastrophic incidents.[4] The National Exercise Program serves to test and validate core capabilities. Participation in exercises, simulations, or other activities, including real world incidents, helps governments and organizations validate their capabilities and identify shortfalls. Exercises also help governments and organizations see their progress toward meeting their preparedness objectives.

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[1] http://www.usgs.gov/blogs/features/usgs_top_story/new-insight-on-the-nations-earthquake-hazards/
[2] U.S. Geological Survey, "Technical Implementation Plan for the ShakeAlert Production System—An Earthquake Early Warning System for the West Coast of the United States," available at http://pubs.usgs.gov/of/2014/1097/pdf/ofr2014-1097.pdf.
[3] Id.
[4] 6 U.S.C. §748.

In the last four years, FEMA has organized several exercises focused on earthquake hazards. The National Level Exercise in 2011 simulated the catastrophic nature of a major earthquake in the central United States region of the New Madrid Seismic Zone. It included participants from various federal, state, and local agencies, as well as private sector and nonprofit organizations. The exercise lasted four days and included more than 4,000 federal employees from 43 departments and agencies. While federal and regional earthquake plans were effectively exercised, there were important lessons learned regarding liability and licensure concerns with Urban Search and Rescue teams that delayed deployment, and it was realized that there were not enough resources or facilities available to support mass healthcare.

The Capstone Exercise in 2014 used the 1964 Great Alaskan Earthquake, which resulted in significant damage from both the quake and the tsunami it triggered, as the basis of the exercise scenario. The exercise examined federal stakeholders' ability to demonstrate operational coordination and information sharing capabilities with the private sector and other non-traditional partners as well as fulfill mandated exercise requirements or internal assessments to validate capabilities and identify key issues or potential shortfalls. One of the greatest lessons learned through this exercise was the movement and prioritizations of assets, particularly to remote areas.

The 2015 National Level Exercise will use the scenario of a 7.8 magnitude earthquake on the Southern San Andreas Fault. This scenario will build upon the lessons learned from previous exercises and continue to test FEMA's national and regional teams, as well as their speed and ability to execute mission assignments.

Encouraging Mitigation through the National Earthquake Hazards Reduction Program

The federal government has supported efforts to assess and monitor earthquake hazards and risk in the United States under the National Earthquake Hazards Reduction Program (NEHRP) program since 1977. The four federal agencies that have responsibility for long-term earthquake risk reduction are FEMA, the U.S. Geological Survey, the National Science Foundation, and the National Institute of Standards and Technology. These agencies coordinate their activities to assess U.S. earthquake hazards and conduct research to help reduce overall U.S. vulnerability to earthquakes.

FEMA is responsible for translating research and lessons learned from earthquakes into guidance, training, support for states and multistate consortia, and other program implementation activities. FEMA works with national model codes and standards groups; promotes better building code practices; assists states in developing mitigation, preparedness, and response plans; aids in the development of multistate groups; and supports comprehensive earthquake education and awareness. FEMA also develops and disseminates earthquake-resistant design guidance for new and existing buildings and lifelines and aids in the development of performance-based design guidelines and methods. FEMA applies earthquake hazards reduction measures, where applicable, to other natural and man-made hazards; provides preparedness, response, and mitigation recommendations to communities; and establishes demonstration projects on earthquake hazard mitigation to link earthquake research and mitigation with emergency management programs.

In 2004, Congress reauthorized NEHRP through FY 2009. Total funding enacted from reauthorization through FY 2009 was $613.2 million, approximately 68 percent of the total amount of the $902.4 million authorized. Although authorization for appropriations expired in 2009, Congress has continued to appropriate funds for NEHRP activities. NEHRP agencies spent $119.5 million for program activities in FY 2013, less than FY 2012 spending of $124.1 million and less than the FY 2014 enacted amount of $121.4.[5] Specifically, for FEMA activities, $23.6 million was authorized in 2009. Since, FY 2011, FEMA has dedicated $7.8 million annually from its appropriations for activities under the NEHRP program.

Urban Search and Rescue Teams are Essential to Earthquake Response

One of the most critical resources available for earthquake response is Urban Search and Rescue (USAR) teams. These task forces are comprised of first responders, firefighters, medical professionals, engineers, emergency managers, and others and can be deployed to rescue victims of structural collapses during disasters, particularly earthquakes.

The capabilities of the USAR task forces include:

- Conducting physical search and rescue in collapsed buildings;
- Providing reconnaissance to assess damage and needs;
- Rendering emergency medical care to trapped victims;
- Canine search-and-rescue;
- Assessing and controlling hazardous materials, electrical services, and gas leaks;
- Providing structural evaluations of buildings; and
- Evaluating and stabilizing damaged structures.

Encouraging Mitigation Through Recovery

In a catastrophic disaster, if the governor requests assistance, FEMA can mobilize federal resources for search and rescue, electrical power, food, water, shelter, and other basic human needs. But long-term recovery can place severe financial strain on state, tribal, or local governments. Damage to public facilities and infrastructure, often not insured, can overwhelm even a large city.

During the rebuilding phase, FEMA encourages communities to include mitigation measures as they reconstruct. FEMA also encourages the avoidance of future loss of life and property through hazard mitigation. FEMA helps fund measures like retrofitting buildings to make them resistant to earthquakes

Efforts to Prepare for Pacific Northwest Seismic Hazards

Scientists have recently discovered new faults and continue to apply new data, raising earthquake hazard estimates for several areas in California and increasing the estimates of a magnitude 9.3 earthquake along the Cascadia Subduction Zone.

[5] Congressional Research Service, "The National Earthquake Hazards Reduction Program (NEHRP): Issues in Brief," published August 27, 2014.

January 26, 2015, marked the 315th anniversary of the last great earthquake along the Cascadia Subduction Zone. The quake, which took place in 1700, was estimated to be around 9.0 in magnitude. For years, scientists have warned residents in the Pacific Northwest that the area is due for another massive earthquake. An event of this magnitude has historically occurred approximately every 300 years.

Oregon's Earthquake Commission and Resilience Plan

As a result of the Loma Prieta Earthquake in the Bay Area of California in 1989, Oregon formed the Oregon Seismic Safety Policy Advisory Commission (OSSPAC or the "Earthquake Commission") in 1991. The Earthquake Commission has the unique task of promoting earthquake awareness and preparedness through education, research, and legislation. Their mission is to positively influence decisions and policies regarding pre-disaster mitigation of earthquake and tsunami hazards, increase public understanding of hazard, risk, exposure, and vulnerability through education, and be responsive to the new studies and/or issues raised around earthquakes and tsunamis.

Since its inception, OSSPAC has continued to increase Oregon's awareness of earthquake hazards by supporting earthquake education, research, and legislation. Most recently, in February 2013, the Commission released the Oregon Resilience Plan launching a sustained program to reduce the state's vulnerability and reduce recovery time to achieve resilience before the next Cascadia earthquake strikes.[6]

The Development of an Earthquake Warning System

Today, the technology exists to detect earthquakes so quickly that an alert can reach some areas before strong shaking arrives. Since 2006, earthquake experts with the U.S. Geological Survey and a coalition of university partners, including the California Institute of Technology and the University of California at Berkeley, have been developing an earthquake early warning system for the West Coast. Using a network of sensors across the state, the system, called ShakeAlert, began sending notifications of quakes in 2012 to a selected group of test users including California emergency management agencies, transit agencies, utilities, and private companies. An earthquake warning system began testing in the Pacific Northwest earlier this year.

The purpose of an earthquake early warning system is to identify and characterize an earthquake a few seconds after it begins, calculate the likely intensity of ground shaking that will result, and deliver warnings to people and infrastructure in harm's way. Studies of earthquake early warning methods in California have shown that the warning time could range from a few seconds to a few tens of seconds, depending on the distance to the epicenter of the earthquake.

For very large events like those expected on the San Andreas fault or the Cascadia Subduction Zone, the warning time could be much longer because the affected area is much larger. ShakeAlert can give enough time to slow and stop trains and taxiing planes, to prevent cars from entering bridges and tunnels, to move away from dangerous machines or chemicals in work environments, and to take cover under a desk, or to automatically shut down and isolate industrial systems. Taking such actions before shaking starts can reduce damage and casualties

[6] Available at http://www.oregon.gov/OMD/OEM/osspac/docs/Oregon_Resilience_Plan_Final.pdf

during an earthquake. It can also prevent cascading failures in the aftermath of an event. For example, isolating utilities before shaking starts can reduce the number of fire initiations.

Implementing and Enforcing Building Codes

Building codes are sets of regulations governing the design, construction, alteration, and maintenance of structures. They specify the minimum requirements to adequately safeguard the health, safety, and welfare of building occupants. Some provisions within the International Building Code (IBC), International Residential Code (IRC), and International Existing Building Code (IEBC) are intended to ensure that structures can adequately resist seismic forces during earthquakes. These seismic provisions represent the best available guidance on how structures should be designed and constructed to limit seismic risk.

Adoption of the model codes is uneven across and within states, even in areas with high levels of seismic hazard. Some states and local jurisdictions have adopted the codes but have made amendments or exclusions relating to the seismic provisions. And adopting the latest building codes is only part of the solution. Codes must also be effectively enforced to ensure that buildings and their occupants benefit from advances in seismic provisions in the model codes. For the most part, code enforcement is the responsibility of local government building officials who review design plans, inspect construction work, and issue building and occupancy permits.

Many of our Nation's communities have older structures that were built before building codes included seismic standards, and the buildings have not yet been replaced or substantially altered. It is possible to make these buildings more resistant to earthquakes through seismic retrofitting. Seismic retrofitting of vulnerable structures is critical to reducing risk. But until the buildings are retrofitted, they remain the single biggest contributor to seismic risk in the United States today.

CONCLUSION

Past earthquakes and related hazards have impacted communities across the country and such events will happen again. A single large event could cause thousands of deaths and tens of thousands of injuries from the shaking alone, and many more from possible resulting fires, hazards, and other hardships that come in the wake of large quakes. Through close coordination of federal partners and the engagement of state, local, and tribal governments, scientists, and the private sector, adequate warning and planning can help communities protect lives, property, livelihoods, and prosperity for the future. There are lessons to be learned from the activities on the West Coast, but there is much work to be done to reduce the catastrophic impacts of earthquakes across the United States.

WITNESS LIST

Mr. Robert J. Fenton, Jr.
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Office of Response and Recovery
Federal Emergency Management Agency

Dr. Scott A. Ashford
Dean, College of Engineering
Oregon State University

Dr. Richard M. Allen
Director, Berkeley Seismological Laboratory
University of California Berkeley

Mr. John Hooper
Director of Earthquake Engineering, Magnusson Klemencic Associates
On Behalf of
American Society of Civil Engineers

PACIFIC NORTHWEST SEISMIC HAZARDS: PLANNING AND PREPARING FOR THE NEXT DISASTER

TUESDAY, MAY 19, 2015

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, PUBLIC BUILDINGS, AND EMERGENCY MANAGEMENT,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to call, at 10:35 a.m., in room 2167, Rayburn House Office Building, Hon. Ryan A. Costello presiding.

Mr. COSTELLO. Good morning. The subcommittee will come to order. Welcome to today's hearing entitled "Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster."

The purpose of today's hearing is to examine the Federal Emergency Management Agency, FEMA's role in earthquake hazard preparedness, mitigation, response, and recovery. We are also going to speak with some of the world's leaders in seismology and earthquakes.

I want to thank Ranking Member DeFazio for his leadership on this critical national issue. He has been an advocate for his State and the Pacific Northwest supporting preparedness and mitigation efforts and the development of a public west coast earthquake early warning system.

Just last week, we saw the second devastating earthquake strike Nepal. Our thoughts and prayers go out to those impacted and the thousands that are working to help.

We know earthquakes pose one of the greatest natural hazards here in the United States. They strike without warning and result in potentially catastrophic casualties and damage to buildings and infrastructure.

Portions of all 50 States and the District of Columbia are vulnerable to earthquake hazards. Earthquakes cannot be prevented, but their impacts on life, property, and the economy can be managed.

FEMA is responsible for coordinating the Federal response to a catastrophic earthquake and has been diligently working to help States plan and prepare for the inevitability of an earthquake. FEMA has a robust National Exercise Program that in recent years has tested State and regional earthquake response plans in Alaska, in the South and Midwest, along the New Madrid Seismic Zone, and just last week in California.

We know that FEMA's national urban search and rescue teams are key assets in the wake of disasters like earthquakes. This Congress, H.R. 1471, the FEMA Disaster Assistance Reform Act of 2015, which was voted out of committee in April, reauthorizes the USAR program and provides key protections to the individuals who serve on those teams.

We also will hear from Dr. Ashford about the earthquake threat in Oregon and the Pacific Northwest and the efforts the State has led to bring together all members of the community to strengthen communities.

While we are not able to predict earthquakes, I was excited to learn that Dr. Allen and his colleagues are working with the Federal Government to develop an earthquake early warning system.

Finally, Mr. Hooper has been leading efforts to update model building codes to include the latest engineering and building science to minimize earthquake impacts on buildings. There are lessons to be learned from the efforts of leaders in the Pacific Northwest that should drive the way we plan for and mitigate against disasters.

I look forward to hearing from the witnesses and thank them all for being here today.

I now call on the ranking member of the subcommittee, Mr. Carson, for a brief opening statement.

Mr. CARSON. Thank you, Mr. Costello. And we acknowledge the ranking member, Mr. Peter DeFazio. My good friend Albio is here as well.

Good morning. I join in welcoming today's witnesses for this important hearing.

When someone hears "earthquake," they immediately think of the west coast, but there are actually 42 States at significant risk for a quake. Indiana, the great Hoosier State, is one of them. Two major fault zones run in or near southwestern Indiana, the Wabash Valley Seismic Zone and the New Madrid Zone as well.

In the past, the New Madrid Fault has produced magnitude 7 to 8 earthquakes. If a 7.7 quake from the New Madrid Fault was to occur today, the Mid-America Earthquake Center estimates that it would damage 14,000 buildings, resulting in 2,000 deaths, and cause $12 billion in direct economic loss in Indiana alone.

The Federal Emergency Management Agency, or FEMA, plays an important role in helping the Nation address earthquake risks. I appreciate that the 2011 National Level Exercise tested earthquake plans in the New Madrid Zone. Indiana had many participants and learned a great deal, including the need to address urban search and rescue issues beforehand. As a result of this exercise, communication has increased among the States affected by the New Madrid Fault.

Last year, several public and private agencies in Indiana participated in the Central United States Earthquake Consortium multistate CAPSTONE–14 exercise. That exercise assessed national and regional response and recovery capabilities after a quake on the New Madrid Zone. Building on the 2011 exercise, the Hoosier State focused on housing recovery support functions to address post-disaster housing issues and to facilitate delivery of resources

to local governments for reconstruction. This exercise provides valuable insight into what works and what needs improvement.

FEMA has statutory duties under the National Earthquake Hazards Reduction Program, or NEHRP, and I would like to see this subcommittee take a really more active role in the reauthorization of this program. We need to ensure that FEMA is fulfilling its mission and has adequate authority and funding levels to perform its duties. The GAO has identified no-notice catastrophic events such as earthquakes as one of the greatest emergency management challenges that FEMA faces. We cannot ignore this issue.

And finally, I would be remiss to not recognize and commend the urban search and rescue teams that are assisting in the aftermath of the two recent Nepal quakes. Their training and skills are being put to effective use. Once again they are putting their lives at risk to help others around the world. This is a perfect example of why Congress needs to ensure the teams have the protection and benefits they deserve. Congress needs to move forward quickly on H.R. 1471, the FEMA Disaster Assistance Reform Act of 2015, which was recently reported from this committee.

Thank you. And I yield back, Mr. Chairman.

Mr. COSTELLO. Thank you, Ranking Member Carson.

I now call on the ranking member of the full committee, Mr. DeFazio.

Mr. DEFAZIO. Thank you, Mr. Chairman. Appreciate your bringing attention to this.

I would observe, unfortunately, here in Washington, DC, we seem to have what I call a tombstone mentality, which if this were the day after the Cascadia Subduction Fault or a big earthquake on New Madrid the room would be packed, press would be out in the hallways, and we would have lines waiting.

But the sad fact is that if we are better prepared, if we invest in resilience, if we invest in the case of the west coast and an early warning system, we can save potentially thousands of lives and billions of dollars in infrastructure and economic damages and losses.

The Cascadia earthquake, basically it is inevitable. The question is when and what will we do to prepare for it before then. I did get a minor provision in H.R. 1471 that would encourage States to use hazard mitigation and support of building capability for earthquake warning, except, unfortunately, FEMA is underinvesting in that program.

For the Pacific Northwest, Oregon, Washington, at risk, and northern California, for $38 million the Government of the United States of America could fund a real-time, at-sea-based early warning system which would give people halfway up the coast a couple of minutes to get out of inundation zones. It would give people in Portland maybe 7 minutes to shut down the Metro, get people off the bridges, shut down manufacturing processes, et cetera, over in the valley. We would have 5 to 7 minutes to evacuate schools made out of bricks that are going to fall down and kill the kids.

But we don't have that because we are the United States of America and we can't afford $38 million to save thousands of lives. And then everybody would be pointing fingers the day after the quake and say: Why didn't we do that, just like with Amtrak, and

we can and we should. And so I am really pleased you are holding this hearing here today.

I want to particularly thank Dr. Scott Ashford, dean of Oregon State University's College of Engineering. He has worked very closely with the State of Oregon on an earthquake resilience plan. We are really at the beginning stages. Our legislature is deciding whether to commit more and how much State money to that sort of predisaster investment, and he has played a very key role in that.

With that, I look forward to hearing from the witnesses. Thank you, Mr. Chairman.

Oh, I would like to put my entire statement, which is long and very thoughtful and more detailed, in the record, without objection.

Mr. COSTELLO. Without objection. Thank you, Mr. DeFazio.

We will have a single panel of witnesses today. We have Mr. Robert J. Fenton, Deputy Associate Administrator, Office of Response and Recovery at FEMA; Dr. Scott A. Ashford, dean of the College of Engineering at Oregon State University; Dr. Richard M. Allen, director of the Berkeley Seismological Laboratory at UC Berkeley; and Mr. John Hooper, senior principal and director of Earthquake Engineering at MKA [Magnusson Klemencic Associates], representing the American Society of Civil Engineers.

I ask unanimous consent that our witnesses' full statements be included in the record. Without objection, so ordered.

Since your written testimony has been made a part of the record, the subcommittee would request that you limit your oral testimony to 5 minutes.

Mr. Fenton, you may proceed.

TESTIMONY OF ROBERT J. FENTON, DEPUTY ASSOCIATE ADMINISTRATOR, OFFICE OF RESPONSE AND RECOVERY, FEDERAL EMERGENCY MANAGEMENT AGENCY; SCOTT A. ASHFORD, PH.D., DEAN, COLLEGE OF ENGINEERING, OREGON STATE UNIVERSITY; RICHARD M. ALLEN, PH.D., DIRECTOR, BERKELEY SEISMOLOGICAL LABORATORY, UNIVERSITY OF CALIFORNIA, BERKELEY; AND JOHN D. HOOPER, SENIOR PRINCIPAL AND DIRECTOR OF EARTHQUAKE ENGINEERING, MAGNUSSON KLEMENCIC ASSOCIATES, ON BEHALF OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Mr. FENTON. Vice Chairman Costello, Ranking Member Carson, and members of the distinguished subcommittee, as a fifth-generation San Franciscan who has served 13 years for FEMA Region IX's Oakland office in California and will soon be reporting as its Regional Administrator, I understand the significant threats that catastrophic earthquakes pose to our Nation. We have seen in recent weeks the devastating consequences of both the 7.3 and 7.8 magnitude earthquakes that struck Nepal, and our thoughts continue to be with the survivors.

Catastrophic earthquakes of that magnitude in an urban area in the United States would impact millions of people and cause profound social and economic impacts. That is why it is vitally important that the Federal Government maintain a forward-leaning posture and be ready to act decisively at the direction of the President

to effectively support State, local, tribal, and territorial governments in saving lives and protecting property.

I appreciate the opportunity today to update you on FEMA and our whole-community partner efforts to improve our Nation's preparedness for earthquake threats and to maintain our readiness to respond.

Over the past 4 years, and at the direction of the President, FEMA and our partners have worked to develop and implement the National Preparedness System, which includes a national planning framework for each of the five mission areas: prevention, protection, mitigation, response, and recovery. These frameworks identify how the whole community will build and deliver the core capabilities required to address the threats that pose the greatest risks to our Nation.

In support of the national response and recovery frameworks, we recently developed Federal interagency operational plans which are all-hazards plans based on a maximum of maximums scenario that includes catastrophic incidents and cascading impacts, including a major earthquake.

In addition to the Federal interagency operational plans, FEMA has developed five national-level incident annexes, one of which is focused on earthquakes.

In addition, we have recently facilitated the development of all-hazards plans in each of our 10 regions and developed 31 regional incident annexes. The one I am holding today is for the Cascadia Subduction Zone in the Pacific Northwest.

Recognizing this, FEMA, in coordination with our State, local, tribal, and territorial partners, is constantly seeking ways to improve our ability to address potential threats and risks associated with catastrophic events such as earthquakes. Through our National Exercise Program, the whole community continues to test, improve, and assess national preparedness across the whole homeland security enterprise.

This year FEMA participated in the southern California earthquake exercise involving a magnitude 7.8 earthquake on the San Andreas Fault. FEMA, in conjunction with our partners, is analyzing the results of the exercise and will integrate lessons learned into our plans, doctrine, and operations as required.

In addition to the planning and exercising that FEMA supports with our whole community partners, I also want to highlight our efforts in improving individual preparedness for earthquakes.

In 2013, FEMA and our partners unveiled the America's PrepareAthon, a nationwide community-based campaign for action to increase emergency preparedness and resilience. A major activity of the America's PrepareAthon is the Great Shakeout, an exercise whereby millions of people participate in earthquake drills. We continue to see increasing levels of participation in the Great Shakeout.

I would also like to highlight that FEMA has made significant strides in alert and warning systems through our Integrated Public Alert and Warning System for all hazards called IPAWS. Early detection for earthquakes can be difficult. However, I am encouraged by our State partners that are actively installing sensors in the ground to warn of earthquake activities as early as possible.

In conclusion, FEMA is one part of the whole community effort that is required to effectively prepare for, respond to, and recover from disasters. The response to a major earthquake along one of our Nation's fault lines will require resources from across all levels of Government, private sector, and nongovernmental organizations and the public. These are the scenarios that we are planning to exercise against, and we are adapting the way we do business based on these lessons learned.

As outlined in our Administrator's and our agency's 2014 through 2018 strategic plan, we are focusing on strategic priorities, including becoming an expeditionary organization and posturing and building capability for catastrophic disasters. That will help to institutionalize key improvements while building capacity and strengthening national capabilities for disaster preparedness.

I look forward to working with you, distinguished members of this subcommittee, and other Members of Congress, to continue these important efforts. I am prepared to answer any questions the subcommittee has. Thank you.

Mr. COSTELLO. Thank you for your testimony, Mr. Fenton.

Dr. Ashford, you may proceed.

Mr. ASHFORD. Good morning, Mr. Chairman, members of the committee. My is Scott Ashford. I am dean of the College of Engineering at Oregon State University. I am pleased to be before you today testifying on my role as chair of our Governor's Task Force on Resilience Plan Implementation. As chair, I was responsible for advancing Oregon on a path towards resilience in the face of the upcoming mega-quake along the Cascadia Subduction Zone, perhaps the greatest impending natural disaster to face the United States.

I have seen firsthand communities destroyed by earthquakes. Most recently, in Japan I saw the devastation left by the 2011 9.0 subduction zone earthquake and tsunami that killed over 15,000 people and wiped entire communities off the map.

This is a mirror image of what we expect in the Pacific Northwest. The Cascadia Subduction Zone extends from northern California to British Columbia, where a 9.0 magnitude earthquake felt from Salt Lake to San Francisco will shake 3 to 5 minutes and a tsunami will inundate much of the coastline, killing thousands. The last major Cascadia event occurred in the year 1700, and we are now due.

The biggest challenge for Oregon is our legacy infrastructure, vulnerable buildings, bridges, and pipelines that were built before anyone knew that the Cascadia was active.

This problem is not unique. States in the New Madrid Fault Zone, like Indiana, Arkansas, and Kentucky, are also seismically vulnerable because of their legacy infrastructure.

Oregon leaders recognized the need to prepare for the eventual likelihood of a Cascadia event and called for the Oregon Resilience Plan. Our vision is that 50 years from now our businesses and communities will have the resilience to bounce back from this mega-quake. The 300-page report completed in 2013 contains over 140 different recommendations, and, frankly, it was difficult to figure out where to start.

To find a path forward, the legislature formed the Governor's Task Force on Resilience Plan Implementation, which I chaired. Our specific recommendations were submitted to the legislature last September in a 2-page report, which I have submitted as part of my testimony. Based on our report, four bills now sit in our State's Senate Ways and Means Committee waiting for action.

Today, I would like to focus on our recommendations in just three areas where the Federal Government plays a key role in working in partnership with States and private enterprise.

In transportation, mobility is critical to rescue, relief, and recovery efforts following a natural disaster and for the economy to start moving so that people can get back to work. Our State knows what we need to do, but the price tag for the seismic retrofit program in Oregon is over $5 billion. The first phase alone, to strengthen our bridges and prevent landslides in the Cascadia event only along key lifeline routes, is $1 billion. This is definitely an area where enhanced State-Federal partnership is needed, where the State is stuck with a plan but really no money to act.

Around liquid fuels, 90 percent of all liquid fuel used in Oregon comes into one single location extremely vulnerable to damage in an earthquake. But due to the interstate nature of liquid fuel transmission, Oregon has no regulatory authority to act. This is another area where the Federal Government can work with affected States to require seismic resilience of federally regulated utilities.

And finally in research, with the unique combination of a 9.0 earthquake and the legacy infrastructure, applied research is a way that we can assure that precious taxpayer dollars are used in the most value- and cost-informed manner possible. Businesses already understand this. Companies like Portland General Electric and Northwest Natural Gas have joined the BPA [Bonneville Power Administration], the Port of Portland, and ODOT [Oregon Department of Transportation] to form the Cascadia Lifelines Program at Oregon State University. These lifeline providers pool and direct their research dollars in a consortium aimed at finding solutions to the seismic challenges that they jointly face.

Key legislature opportunities in the Congress that can facilitate effective public-private partnerships for applied research include the highway bill with university transportation centers, the National Earthquake Hazards Reduction Program, and seismic research funded by FEMA, NIST [National Institute of Standards and Technology], NSF [National Science Foundation], the USGS [U.S. Geological Survey], and the FHWA [Federal Highway Administration].

In closing, the Cascadia Subduction Zone is estimated to be the single greatest natural threat facing the United States. Oregon is taking steps on its own to mitigate this threat. Other West Coast States and those in the New Madrid Fault Zone can follow our example.

It will take decades and significant resources to improve our resilience, but we need to start now, and we need to all work together collaboratively across Governments, academia, and the private sector. The Federal Government is a critical partner in our ability as a State, a region, and a country to effectively prepare for this impending natural disaster.

Thank you, Mr. Chair, members of the subcommittee, for the opportunity to appear before you today, and I stand ready to answer any questions that you might have.

Mr. COSTELLO. Thank you for your testimony, Dr. Ashford.

Dr. Allen, you may proceed.

Mr. ALLEN. Good morning, Mr. Chairman and members of the committee.

The Pacific Northwest must be ready for a magnitude 9 earthquake. Recent magnitude 9 events around the world include the 2011 Tohoku-Oki earthquake in Japan and the 2004 Sumatra earthquake. These are responsible for tens and hundreds of thousands of lives lost. The last magnitude 9 in the Pacific Northwest was just over 300 years ago, and we are now in the period when we should expect the next megathrust earthquake.

My name is Richard Allen. I am the director of the UC Berkeley Seismological Laboratory and a professor of earth and planetary science. I am also one of the architects of the ShakeAlert earthquake early warning system, a new technology that we hope to roll out along the U.S. west coast to reduce the impacts of the next big earthquake. We would very much like to build this warning system before the next earthquake occurs, but to do that will require action from this legislature.

The ShakeAlert earthquake early warning project is a collaboration between the University of Washington, the University of Oregon, the University of California, Berkeley, the California Institute of Technology, the U.S. Geological Survey, and several State agencies. We are now operating a demonstration earthquake early warning system that issues alerts to a group of test users for events throughout Washington, Oregon, and California.

So what is earthquake early warning? By using networks of geophysical sensors distributed across the west coast, we can rapidly detect the beginnings of an earthquake. ShakeAlert then estimates the size of the event and predicts the shaking intensity that will follow. The warning time depends on the distance from the initiation point. In the case of the Pacific Northwest, if a magnitude 9 starts at the southern end of the Cascadia Subduction Zone, as research suggests, Portland could receive 3 minutes of warning and Seattle as much as 5 minutes.

There are many things that can be done to reduce the impacts of earthquakes with a few minutes of warning. One of my colleagues, Professor Doug Toomey, at the University of Oregon, asked one of his local elementary school principals how long it would take to evacuate his 350-student school built in 1926. His answer: 1½ minutes. This is just 1 of 1,000 schools that a recent Oregon State survey concluded would collapse in a magnitude 9 earthquake.

Studies of injuries caused by the 1994 Northridge earthquake show that more than 50 percent were caused by falling hazards, bookcases, ceiling tiles, lighting fixtures, et cetera. If everyone gets a warning, and if everyone drops, takes cover, and holds on, then we could reduce the number of earthquake injuries by 50 percent.

Other applications of earthquake early warning include automated response of transportation systems, isolation of hazardous machinery and chemicals, opening elevator doors at the nearest

floors to stop people from being trapped, and alerting surgeons to remove the scalpel from inside a patient.

The existing west coast ShakeAlert demonstration system has proven the capabilities of this technology. In the recent magnitude 6 earthquake in Napa, California, ShakeAlert issued a warning across the San Francisco Bay area. Although this is only a demonstration system, it is of such value to the BART train system in the region that they have already implemented an automated train-stopping system.

It takes BART just 24 seconds to bring a full-speed train to a stop, thereby reducing the likelihood of derailment. During peak hours at any point in time, there are between 40 and 45 trains running at full speed, each carrying 1,000 passengers.

Earthquake early warning is not a panacea for the earthquake problem in the Pacific Northwest. It will not prevent buildings from collapsing, and we must continue to make progress improving our buildings so they will not collapse, as Dr. Ashford was just discussing. At the same time, ShakeAlert provides a new opportunity to reduce the impact of coming quakes.

So what will it take to build an earthquake early warning system for the U.S. west coast? The U.S. Geological Survey is the Federal agency with the responsibility for issuing alerts, but there is a critical role for the private sector. Their expertise is needed to distribute the alerts broadly through cell phones, Internet providers, TV, and radio. Building a public warning system will also create new business opportunities to provide specialized alerts to specific users and the development of automated control systems.

Building the system is not expensive. The U.S. Geological Survey has developed an implementation plan for the U.S. west coast. This system could be operational in 2 years if the necessary funding is made available. The cost of operating the system would be $16.5 million per year above what is currently spent.

Last year, Congress appropriated $5 million to begin the process of transitioning from the current demonstration system to a full-blown public system. Thank you for that. The U.S. Geological Survey and west coast universities are now using those resources to improve the geophysical network infrastructure to make the current system faster and more robust. This is a great first step, but the full implementation plan needs to be funded.

In closing, the earthquake threat along the U.S. west coast increases every day as the strain on the faults builds. It is not if, but when will the next earthquake strike, and we are due for an earthquake in multiple locations.

Earthquake early warning is a new and important tool to have in our disaster preparedness kit. Japan has a warning system, Mexico has a warning system, China, Taiwan, Turkey, and Romania have systems.

If there was an earthquake today, I believe we would build this warning system tomorrow. Let's not miss this opportunity and let's get ShakeAlert funded today.

Thank you.

Mr. COSTELLO. Dr. Allen, thank you.

Mr. Hooper, please proceed.

Mr. HOOPER. Vice Chairman Costello and distinguished members of the subcommittee, I am John Hooper, a senior principal and director of earthquake engineering with MKA in Seattle. On behalf of the American Society of Civil Engineers, it is my pleasure to provide this testimony.

In addition to designing building structures throughout the country, I have also participated in building code development and earthquake engineering research for over three decades. I have served in various capacities for these efforts, and am currently the chair of the American Society of Civil Engineers Seismic Subcommittee.

This subcommittee is tasked with developing the seismic requirements for the vast majority of jurisdictions throughout the United States. Jurisdictions adopt these seismic requirements by voluntarily adopting the International Building Code, or IBC, a comprehensive code that provides requirements for building design and performance.

The majority of State jurisdictions also adopt the IBC. The IBC then references "ASCE 7 Minimum Design Loads for Buildings and Other Structures" for the design requirements for most natural hazards, including seismic.

A major contribution to the evolution of seismic design, however, was development of "NEHRP Recommended Seismic Provisions for New Buildings and Other Structures," originally published in 1985. These seismic design guidelines were developed with the leadership and support from FEMA. These NEHRP provisions have been continually updated since that first version and with the next version due out at the end of this year.

The provisions also serve as a resource document to the seismic design requirements currently found in ASCE 7, a collaboration that has been in existence for over 20 years.

The potential of a Cascadia Subduction Zone was not really fully understood until USGS research occurred in the late 1980s and was presented to the structural engineering community in the Pacific Northwest. Based on this research, the seismic zone maps in the 1994 UBC [Uniform Building Code] were modified to include the effects of the Cascadia Subduction Zone for the first time. So buildings up to that point did not include that seismic hazard in the design of those structures.

Policymakers, emergency planners, and engineers in the Northwest are very aware of the shaking that can result from Cascadia. Due to continued publicity regarding new research that is published in the newspapers throughout the Northwest, the public is fairly clear about the shaking that could occur, but not what the performance of buildings is really going to be like. They are not really aware of what we design to.

So a quick summary of what performance goals we achieve or try to achieve. Given a rare event, we are out there to protect life, and doing so we may not necessarily achieve economically feasible repairs to a building in that case. For critical buildings like hospitals and fire stations, et cetera, we achieve a higher performance with the intent that these facilities will experience damage but will be functional following rare earthquake ground shaking.

To provide more resilient designs, though, a change is required in these seismic performance goals. This change will come with increased construction costs, however. Some Federal, State, and local jurisdictions have provided or are considering providing enhanced performance for some of their projects. Some large companies that would be financially affected by extended shutdowns have already done so.

Typically, though, private owners and developers are generally unaware of what the building code gives them. And the few that do would use enhanced performance designs if they could have a reasonable return on their investment.

Changing the design approach for an entire community to increase resiliency will be a challenge. First, the turnover of building stock in a typical community is low, so enhancing the performance of existing buildings will require seismic upgrading. However, it is not necessary that all buildings achieve enhanced performance to achieve a resilient community. Careful planning is needed to determine which buildings and facilities should be subject to enhanced seismic design or seismic upgrade.

Second, and equally important, for a community to be resilient, the remainder of the community's lifelines must also be seismically designed or upgraded to an enhanced level as well.

Finally, to achieve a resilient community, the key element is to fund these capital costs. Regardless of these challenges, through policymaker leadership and careful community planning, the beginnings of resilient communities can and increasingly will be achieved.

As previously mentioned, NEHRP has made significant contributions. NEHRP makes Americans safer and our Nation more secure, resilient, and financially stronger through research in the earth sciences, public policy, and engineering. ASCE and I urge you to work with the Science, Space, and Technology Committee to reauthorize this vital program.

Thank you for the opportunity to share my views. I am able to answer any questions that you may have.

Mr. COSTELLO. Thank you, Mr. Hooper.

I will now begin the first round of questions limited to 5 minutes for each Member. If there are additional questions following the first round, we will have additional rounds of questions as needed.

Given Ranking Member DeFazio's strong interest and leadership on this issue, I would like to yield my time for questions to him.

Mr. DeFazio, you are recognized for 5 minutes of questions.

Mr. DEFAZIO. Thank you, Mr. Chairman. That is very generous of you.

First to FEMA, I note that the National Earthquake Hazard Reduction Program gets $7.8 million of funding. Given what you just heard today, don't you believe that we should perhaps be investing more money in that program to deal with both early warning and other things that have just been talked about in terms of mitigation?

Mr. FENTON. Sir, the NEHRP program is one program among many programs and resources we have to assist in this issue. I went over a number of them in my opening. The planning that we provide, we probably have millions of dollars in planning each year.

We have requested money for predisaster mitigation this year. There is also post-disaster mitigation.

So all those together provide a significant number of resources. I think we need to continue to look at the issue and continue to work with them, our partners across this table, to——

Mr. DEFAZIO. Right. Now, the early warning issue, I am looking at giving you specific authorization since it hasn't been given a priority. Why hasn't it been given a priority? I mean, you just heard here we can save thousands of lives, potentially mitigate billions of dollars—well, at least a lot of damage in terms of shutting down systems, et cetera, with warning.

Mr. FENTON. Sir, we are looking into early warning systems. As you know, we have had early warning systems for years now.

Mr. DEFAZIO. OK. All right. Thanks. OK. That is good. We want to do more than look into them.

I guess first I will go to Dr. Allen.

You talked about the system, $38 million land-based. Would there be any advantage to having something that was based in the ocean? The Japanese have put sensors in the ocean. Does that give you more time?

Mr. ALLEN. Absolutely it gives you more time. The piece I focused on is the onshore piece. So it is $16 million per year to run, plus $38 million capital investment to have it running in 2 years.

Mr. DEFAZIO. Right.

Mr. ALLEN. We have an implementation—we, the USGS, the west coast universities—have an implementation plan for that. It is a proven technology. So that is what we would like to do first.

But in addition to that, as you say, if we were to put out additional sensors on the end of a cable, particularly in the Cascadia Subduction Zone, that would get us more sensors closer to the fault, and that would simply give us more warning time.

Mr. DEFAZIO. OK. Thanks.

And then, Dr. Ashford, the work you have done, the $1 billion just for key lifeline routes in the little State of Oregon, that is because of bridge collapse and other, maybe landslides, I guess.

Mr. ASHFORD. Yeah. That was just the backbone route, actually east of the Cascades and down through part of the Willamette Valley, and that is for strengthening bridges and trying to mitigate the landslides.

Mr. DEFAZIO. So what you are thinking is the east side of the Cascades will be less impacted, and then you would run lifeline routes down through the Cascades down to where all the people live.

Mr. ASHFORD. That is right. But even with that, all of the routes to the coast would be shut down from bridge failure and landslides, and all of U.S. Highway 101 would also be shut down.

Mr. DEFAZIO. OK. That is a bit sobering.

Give me that list again of countries that have early warning systems. I think you said Japan, China, Taiwan, Romania.

Mr. ALLEN. That is right. Mexico and Taiwan.

Mr. DEFAZIO. Mexico, yeah. I saw a very dramatic, actually, illustration of Mexico, which gives you the idea—I mean, the fault, I guess, is quite close to Mexico City, but it was in a TV station. Guy is broadcasting the news. He suddenly starts talking very

quickly. My Spanish isn't that good, but I get the idea something is going on, and he talks for a full minute before things start falling down in the studio, and he is basically telling people to run for shelter. That is 1 minute with approximate, let alone what you could do with a longer——

Mr. ALLEN. That is right. And the analogy to the Cascadia Subduction Zone is exactly the right one in that it is offshore subduction zone earthquakes that Mexico City is worried about. Mexico City is onshore, and they have a little bit over a minute's worth of warning, as you say.

In the case of the Pacific Northwest, the warning time will increase with distance up or down, but the people who are closest to the event would have less warning time, that is right.

Mr. DEFAZIO. OK. Thank you.

And if we had this offshore, I mean, do have an estimate on what an offshore? The Japanese are deploying offshore, so we must—I mean, there is a known technology. Is that correct?

Mr. ALLEN. That is correct, yes.

Mr. DEFAZIO. OK. And, obviously, since you have to lay a cable, it is more expensive.

Mr. ALLEN. That is right.

Mr. DEFAZIO. And you have to put things on the sea floor. So——

Mr. ALLEN. Yeah. I do not have a cost estimate that I can tell you.

Mr. DEFAZIO. OK.

Mr. ALLEN. It is significantly more expensive than onshore, and it is primarily because of putting out the offshore cable. But there is no question that what that would allow us to do in terms of early warning would be significant.

Mr. DEFAZIO. Well, I note that a—I can't remember who it is—but some major cable company is going to lay a new super fiber optic cable from Bandon to Asia. Maybe we can just run a little splice off that, and maybe we should look into that and see if we can somehow get spliced into that.

So I guess that is it, Mr. Chairman. I would just observe that this is very, very shortsighted that we won't partner. My State is ponying up a little money. We were gong to lose the little bit of land-based detection we had now. It was temporary, and it was going to be moved to Alaska, and I got the State to put up, I think, $440,000 to buy the sensor in place.

So States will be willing to partner, but this should be a shared responsibility to build out a robust early warning system, save lives. And it will save manufacturing processes. It will potentially save the Metro system in Portland if they aren't running the light rail over the bridges when the bridges go down.

There will be one bridge that survives in Portland, which happens to be the brand new light rail pedestrian bridge. It is the only one probably that will survive. And that was a substantial Federal investment partnering with the State.

Thank you, Mr. Chairman.

Mr. COSTELLO. Mr. Carson.

Mr. CARSON. Thank you.

I am curious. There was a recent article in Science magazine talking about the usage of GPS smart phones, to add on to Ranking

Member DeFazio's question, assisting in detecting earthquakes essentially. Is it feasible that this technology could be incorporated into the existing warning system? And at what point, if you could project, when will our early earthquake detection systems be compatible with cell phones and other personal devices?

Mr. ALLEN. So yes. The answer is yes. It is feasible that we could use the sensors in smart phones. The article that you are talking about was actually trying to use the GPS sensor in a smart phone.

There are also projects, including one at Berkeley, to use the accelerometer in the cell phone. So now we are talking about using the seismometer component and the GPS positioning component.

So there are multiple projects out there that are exploring this use. I lead one of them. So clearly I think that there is real value to these systems. But I think it is important to separate clearly the smart phone-based kind of systems from the ShakeAlert demonstration system that we are running today.

The ShakeAlert demonstration system is using what we now call traditional geophysical networks, which are hardened. They are more robust. We know that they will work. We know that they deliver warnings. They delivered warnings in the Napa earthquake.

Cell phones, I believe, will help us improve the system in the future, but that is very much a research undertaking at this stage. It is not ready to start delivering public safety alerts.

Mr. CARSON. OK. Next question. Have the lessons learned from the last year's National Level Exercise on the Alaska earthquake scenario been compiled and publicly released? And, generally, in your mind, what is FEMA's timeframe for compiling and even publicly issuing lessons learned from that exercise to ensure that plans can be improved and even tested in the next exercise?

Mr. FENTON. Yes, sir. My understanding is the lessons learned from last year's earthquake exercise have not been fully released yet. However, we have released some summaries of some of those lessons learned.

Just from the recent exercise last week with southern California, there are a number of things that we are looking at with regard to prioritization and movement of assets, operational coordination, working with the private sector more closely, international support, especially when it comes to USAR and some of the legal issues there, and then some of the planning issues that we have already seen.

We haven't waited for the official after-action report to start taking action to improve on those lessons learned, and we continue to do that.

Mr. CARSON. Thank you.

Thank you, Mr. Chairman. I yield back.

Mr. COSTELLO. Thank you.

Mr. Perry.

Mr. PERRY. Thank you, Mr. Chairman.

Dr. Ashford and Dr. Allen, what potential is there for public-private partnerships to improve earthquake preparedness and response? And do you have any examples of successful partnerships that have emerged surrounding your particular work?

Mr. ASHFORD. Yeah. Thank you, Mr. Congressman.

I think one example is this Cascadia Lifelines Program that we have established at Oregon State University. This was where we have private companies together with State and Federal agencies pooling research funds to address joint challenges that all these lifeline providers face in the face of this Cascadia event. And it is funded and directed by these partners, both in the private sector as well as the public sector.

Mr. ALLEN. And in the case of the earthquake early warning effort, very much to build the fully effective system is a public-private partnership. And what I mean by that is that we see the geophysical networks that are run by Federal agencies, State agencies, and universities, academic institutions, providing the kernel of the alert. But it is the private sector that is going to get that alert out to everybody most effectively.

And so already we have partnerships with groups. Although this is a demonstration system and it is not public, there are groups who want to be participating in issuing the alerts, companies that have cell phone apps, companies that use dedicated radios like the NOAA weather radios, for example, things like that.

And so the private sector is ready. When we have a public system, when we put out these sensors, when we issue these alerts, they are ready to then take it and deliver it to everybody in a multitude of ways. And so that is really the kind of private-sector part of the project.

Mr. PERRY. So in that vein, could there be a public-private partnership in terms of post-earthquake damage assessment regarding the use of unmanned aerial systems? Have you looked into that at all?

Mr. ASHFORD. Yeah. That is something that we at Oregon State University, we have several experts on unmanned aerial systems, and one of the things that we are considering is doing post-earthquake evaluation of infrastructure using those UAVs.

Mr. PERRY. And they would be by private entities as opposed to, say, FEMA, for instance?

Mr. ASHFORD. Yeah. They could be by private entities. Really, people would buy the UAVs to inspect their own infrastructure. So private companies like Portland General Electric, Northwest Natural Gas. I know that ODOT is also considering buying UAVs to do their own inspections. But it could be a private-sector company owns the UAVs and that they are subcontracted out to the agencies.

Mr. PERRY. Dr. Allen, any input?

Mr. ALLEN. So not with UAVs, no. I focus on the early warning piece before the shaking. So that is not really something I have knowledge of.

Mr. PERRY. Thank you, gentlemen.

Mr. Chairman, I yield back.

Mr. COSTELLO. Thank you.

Mr. Sires.

Mr. SIRES. Thank you, Mr. Chairman, for holding this hearing, and the ranking member.

I live on the east coast and I have a stepdaughter on the west coast, and I wanted to be here to hear this. And I heard that you had in your research 140 recommendations that you were able to

determine would help. I don't think you are going to be able to implement a lot of those recommendations because I don't think there is a lot of money here for that.

But I was wondering, of those 140 recommendations, which are the ones that are more reasonable and, quite frankly, less costly to implement? And the reason I say that is because, although it is different, in New Jersey we got hit by Sandy, one of the things that we found out was that gas stations had gas but had no electricity to pump it.

So I was wondering, a reasonable recommendation would be to require these gas stations to have a generator. Can you just talk a little bit about that?

Mr. ASHFORD. Sure. In my task force we took those 140 recommendations and we narrowed it down to about 15 that we thought were the most important. And I will just give you three examples.

Our most important recommendation from our task force was for the Governor to appoint a chief resilience officer or policy adviser, someone that would really take the lead on resilience efforts in the State of Oregon. That is currently in our Ways and Means Committee in the State and pending funding.

I think another example is one of our recommendations is to change hazard preparedness literature to extend the recommendation on how long people should be prepared to be on their own from 72 hours to 2 weeks. Because of the geographical distribution of the damage in these subduction zone events, people should really be prepared for a couple of weeks to be ready.

And I think the last thing, while there is a big price tag on the retrofit of the transportation system, we are taking a 50-year horizon. And I think by starting now and taking our time, I think that is not something we are trying to do all at once, but hoping that we can gain that resilience by the time that next earthquake hits.

Mr. SIRES. Anybody else went to join in on anything?

What can we do to ensure that States are properly developing building codes and enforcing them? Because I see the Tornado Alley. I mean, these homes are made out of wood. I was just wondering, what can we do to force the States to do a better job with the building code?

Mr. HOOPER. The majority of States actually have a building code that they adopt voluntarily and then local jurisdictions do it. So the vast majority have it. The issue on tornadoes is that is a hazard that we do not design for. It is not one of those natural hazards that the ASCE 7 deals with because the return interval on a tornado hitting that house is, like, 100,000 years. It is just literally that act of God.

Mr. SIRES. Yeah. But I was thinking in terms of where you have a school. I mean, we should really make those schools a place where the community gather if there is a catastrophe.

Mr. HOOPER. You can do that with schools. They have had some success in the Midwest in hardening schools and putting safe rooms, big safe rooms in schools. So that technology is available. But just the typical home or mobile home and things like that, that will never be able survive a tornado hit.

Mr. SIRES. But what I am looking for is what can we do to, let's say, tell the State: Look, you have to make these schools, that place where a community meets when there is a catastrophe or in anticipation of one, safer.

Mr. HOOPER. Why don't you go ahead.

Mr. ALLEN. So I guess one comment that I would have to sort of both of these questions is that I think one of the real challenges we face when it comes to all natural hazards is that they don't come around very frequently. I mean, that is good news, right? But the bad news is that it is very difficult, therefore, to get people's attention when it comes to these houses. And that is why these things don't get enforced very effectively sometimes.

And this is actually, I think, one of the areas where the earthquake early warning effort has a potential for a significant broader impact. I mean, we would build an early warning system in order to provide warnings. But early warning has a cache with people because they can envision: Now I am going to get a warning on my cell phone. This is something very real. And we can use that interest to then leverage broader preparedness for, in that case, the earthquake problem.

So I think what we have to do is kind of look for ways to link together these various technology opportunities to also get people's interest and to encourage individuals to take responsibility to have the 2 weeks' worth of supplies or to have a tornado shelter.

Mr. SIRES. And, Dr. Allen, you said that you could evacuate a school in 1½ minutes? I was a teacher for 10 years. I would like to see that.

Mr. ALLEN. That was what the principal of a certain school——

Mr. SIRES. Well, you tell that principal I would like to see that. Thank you very much.

Mr. COSTELLO. Thank you.

I will now recognize each Member for an additional 5 minutes of questions.

I will direct my question to Mr. Hooper, but then ask each of you to weigh in, and I think we are sort of scratching the surface of this question already.

This subcommittee has held a hearing and hosted a roundtable discussion on the dramatic increase in disaster costs and losses. We are working to identify opportunities to drive down the costs of disasters, and particularly the burden on the American taxpayer.

Mr. Hooper, I will start with you, but then open it up to everyone. How can some of the work you are doing potentially reduce disaster costs and losses in the United States?

Mr. HOOPER. Well, we are continually improving the knowledge and the design of how we deal with earthquakes and other natural hazards. The key thing there is to implement that correctly. The designers have to design the infrastructure and the buildings correctly. ASCE 7, the document that everyone uses can do that.

Then we have to get it built correctly. And so there is also this side of making sure it gets constructed the way it needs to be done.

But the other challenge we face, though, is the building turnover, guys, is really short. It takes a long time, meaning every year only one-half of 1 percent of the building stock turns over, so that it will take time to implement better design.

As I mentioned in my testimony, Cascadia did not exist in our design world until 1994. That is probably less than 2 or 3 percent of buildings in the Pacific Northwest that have been designed using that approach and that shaking hazard in mind. So over time we will get better designs as the 50-year window, as mentioned earlier, we will get better improvement just through that window of the length of time.

And so there are a lot of different things happening, but I think time is on our side as long as we continue to implement good design and, very importantly, construction practices.

Mr. ALLEN. So I think that in the case of earthquake early warning, the sort of cost-benefit argument of implementing a system is a very straightforward argument. Some of the examples of what you would save, I mentioned the Northridge earthquake, we know that 50 percent of the injuries were caused by falling hazards. If everybody was under a sturdy table having received a warning, then we would halve the number of injuries. It is estimated that the cost of just those injuries was $2 billion to $3 billion.

When we think about the BART train system, each of the BART trains themselves is worth $30 million. So if you just save 1 train, you have saved $30 million, never mind about the 1,000 passengers that might be on the system.

If we talk about schools that evacuate or other buildings that evacuate, we are talking about both reducing the number of fatalities and the number of injuries.

The list goes on. So in terms of the cost-benefit for an early warning system, I think it is a real slam dunk.

Mr. HOOPER. I would like to add one more comment as well.

I mentioned our performance goal is life safety. That is the major thing in event of an earthquake, protect the people within the building from being killed or seriously injured.

To help improve what we do economically, we need to up the game. We need to shoot for enhanced performance above that level if we really want to try to reduce costs. But in doing that, that requires the building costs to go up as well for anything that gets built new, upwards to 5 or 10 percent more of the construction costs in a school or a highrise or something like that. It doesn't sound like much, but sometimes that is the tipping point between the developer saying yes to a project and no to a project.

But that is something we should dialogue on because to be resilient, to be quite honest, we do need to have better performance in just the life safety that we target today.

Mr. COSTELLO. Anyone else?

Mr. ASHFORD. Yeah. I think that if you look at earthquake research and you look at wise use of taxpayer dollars, I will give you a couple of examples where research has saved millions of dollars with a huge return on the investment.

An example in Oregon. Oregon Department of Transportation invested in about a $2 million research program at Oregon State University ultimately saving $500 million in a bridge retrofit program carried out in the last decade.

Another example, for our Cascadia Lifelines Program, we are looking at innovative ways to retrofit old buildings, old masonry structures, that we, rather than having to tear down a structure,

we can retrofit it, leave it in place, and again save millions of dollars.

Mr. FENTON. Sir, I would just add, codes and standards, I agree with. Through our NEHRP program we do a lot to establish standards to help improve the building codes across the country. There is an enormous amount of literature we provide that is used by the construction companies. This public education is used to make them aware of the threats and to show them what to do when these threats happen.

Mitigation, whether it is building back stronger or moving individuals out of harm's ways, is critically important.

I think some of the new authorities we got after Sandy with regard to 424 allow us to, when we build back, to go ahead and build mitigation into those projects at a higher rate than previously before to build more resiliency.

Mr. COSTELLO. Thank you for your answers there.

Mr. Carson?

Mr. CARSON. Thank you, Chairman.

My final question, is there anything that Congress can do specifically to encourage the private sector to incorporate seismic measures and infrastructure repairs and replacement?

Mr. ASHFORD. I think that one of the things we are looking at in Oregon, especially with our private utilities, is allowing them to recover the cost in their rate base, allowing them to recover the costs not only of the risk assessment, but also their mitigation efforts. And that is some of our recommendations from our task force report, and those are things that are pending in front of the Oregon legislature.

I would say that you could do the same thing for federally regulated utilities.

Mr. CARSON. OK. Thank you.

I yield back.

Mr. COSTELLO. Thank you for your valuable testimony. Your comments have been helpful to today's discussion. If there are no further questions, I would ask unanimous consent that the record of today's hearing remain open until such time as our witnesses have provided answers to any questions that may be submitted to them in writing and unanimous consent that the record remain open for 15 days for any additional comments and information submitted by Members or witnesses to be included in the record of today's hearing. Without objection, so ordered.

I would like to once again thank our witnesses for their testimony today.

If no other Members have anything to add, the subcommittee stands adjourned.

[Whereupon, at 11:31 a.m., the subcommittee was adjourned.]

STATEMENT OF
THE HONORABLE PETER DEFAZIO
SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, PUBLIC BUILDINGS,
AND EMERGENCY MANAGEMENT
HEARING ON "PACIFIC NORTHWEST SEISMIC HAZARDS:
PLANNING AND PREPARING FOR THE NEXT DISASTER
MAY 19, 2015

Thank you, Chairman. I want to welcome all of today's witnesses and thank them for their testimony. Given recent earthquakes in Nepal and the ensuing catastrophe, this is a very timely and important hearing.

In particular, I would like to welcome Dr. Scott Ashford, Dean of Oregon State University's College of Engineering. Dr. Ashford worked closely on the State of Oregon's earthquake resilience plan. His research focus on reducing earthquake losses and improving the resilience of infrastructure systems after an earthquake will provide valuable information to the Committee.

The United States Geological Service (USGS) estimates that 75 million Americans live in areas of significant seismic risk across 42 states. Oregon is one of those states, and is at risk from several different types of earthquakes. But our greatest risk is from the Cascadia Subduction Zone. The Cascadia Subduction Zone stretches from northern California up into British Columbia. It is the mirror image of the subduction zone off the coast of Japan that caused the magnitude nine earthquake and resulting tsunami in 2011. Historically, the Cascadia subduction zone slips every 300 years or so causing major earthquakes. The last quake was in 1700 and

evidence suggests it was a magnitude 8.7 to a 9.2. January of this year marks the 315th anniversary of the last major Cascadia earthquake.

Experts agree that Oregon is due for another major earthquake. Forecasts include a ten percent chance of a magnitude eight to nine quake on the Cascadia Subduction Zone in the next 30 years. Others predict a 35 - 40 percent chance of a major quake on the south end of the Cascadia Subduction Zone in the next 50 years.

A Cascadia earthquake will likely be catastrophic with the potential of triggering a tsunami. The USGS estimates that over 22,000 people live in Oregon's tsunami inundation zone and even more enter the zone daily for employment purposes. The next big Cascadia quake will likely cause massive damage. Critical lifelines, such as power, natural gas, roads and bridges, water and sewer systems, emergency buildings, and communications over large parts of California, Oregon and Washington will likely be damaged, complicating response and recovery efforts.

A catastrophic earthquake is not hypothetical. **It is a not a question of if an earthquake will happen. It is a question of when**. That's why this Nation needs to start taking this threat seriously and begin to prepare for the event. There is a saying that "earthquakes don't kill people, buildings do." In order to minimize the impacts of an earthquake, we need to start investing in the Nation's infrastructure to ensure it can withstand

seismic activity or at the very least minimize potential damages and economic disruption.

We can save lives and prevent injuries by taking common-sense mitigation strategies. We already require new federal buildings to meet seismic standards that are incorporated in building codes. But right now, whether an existing federal building meets seismic standards is only one of many factors considered in determining whether a building should be repaired or altered. In high earthquake risk areas, this should be a prominent factor.

Buildings repaired or rebuilt after a disaster with FEMA funds are subject to state and local building codes. This is sufficient if the state or local government has adopted codes with seismic standards and enforces those codes. But adoption of such codes is uneven amongst and within states, as is code enforcement. If federal funds are going to be used to repair or replace critical infrastructure, FEMA should have the authority to require that those buildings are designed to withstand seismic activity in high risk areas.

Although the State of Oregon requires buildings to be designed to withstand seismic shaking, most of the buildings in Oregon were developed before this code requirement was adopted. Consequently, the majority of buildings in Oregon may not withstand the predicted magnitude nine Cascadia earthquake.

For example, the State of Oregon examined much of its public schools and public safety buildings and found them highly deficient when it comes to earthquake resilience: almost half of the 2,193 public school buildings examined had a high or very high potential for collapse; 982 of the 2,567 highway bridges in the Oregon Department of Transportation were built without seismic considerations, and of the rest, only 409 were designed specifically in consideration of the Cascadia subduction zone. The list of inadequate infrastructure in Oregon goes on.

Luckily, Oregonians takes the earthquake hazard seriously. The State developed the Oregon Resilience Plan, which Dr. Ashford worked on and will be discussing. The Oregon Resilience Plan was a comprehensive look at the state's risk from a catastrophic earthquake and tsunami. This included examining the State's infrastructure and making recommendations to make Oregon more resilient when the next big one strikes. Much more work is needed in Oregon but other States should be encouraged to follow Oregon's lead and examine the risk, the potential damage and develop and implement plans to address the issue.

Another way to save lives, reduce injuries, and minimize infrastructure damage is to invest in an earthquake early warning system. An early warning system can send alerts to trigger automatic shutdowns of trains, manufacturing lines, close bridges, and evacuate students from unsafe schools. It can help reduce the long-term economic losses that are

often excluded from damage estimates. An earthquake early warning system worked during the 2011 Japan earthquake and it can work here.

Incredibly, in the richest and most powerful country in the world – with a very real risk of a costly, catastrophic earthquake – we don't have such a system. That's not only embarrassing, it's pathetic. This is just another example of the United States needlessly falling behind in infrastructure investments. In this case, the USGS has estimated that it would cost about $38 million dollars to install an earthquake early warning system on the West Coast with an additional annual maintenance and operations costs of $16.1 million. This investment could save hundreds of thousands of lives and prevent innumerable injuries in the case of a massive earthquake. Sixteen million dollars is a paltry sum compared to the billions of dollars in damage that is at stake. But, we are only investing about $1 million per year in these systems. Again, one word: pathetic.

Last month, the Committee ordered H.R. 1471, the FEMA Disaster Assistance Reform Act of 2015, to be reported to the House. That bill includes a provision that I sponsored to encourage states to use their hazard mitigation funding in support of building a capability for an earthquake early warning system. FEMA needs to do its part to make sure states are aware that mitigation funds may be used for this purpose.

When it comes to earthquakes, FEMA plays a crucial role. FEMA has many statutory responsibilities under the National Earthquake Hazards Reduction Program, or the NEHRP *(KNEE-HERP)* program to assist States through guidance and implementation. But it does not appear that FEMA is prioritizing this program and its statutory duties.

NEHRP requires FEMA to operate a program of grants and assistance to enable states to conduct seismic safety inspections of critical structures and lifelines. Yet, in its April 2015 update on FEMA's activities under the program, it states that FEMA is not performing critical infrastructure duties. The same update notes several staff vacancies.

The President's Fiscal Year 2016 Budget only requested $7.5 million for FEMA to carry out its NEHRP functions. This is $1 million less than FEMA spent in fiscal year 2014 and about the same as FEMA requested for fiscal year 2015. FEMA has the discretionary authority to determine how much to allocate to the NEHRP program yet it is not even allocating sufficient funds to carry out all of its duties. I hope FEMA intends to start prioritizing this program.

The Oregon Resilience Plan contains a sobering warning that applies to the country more broadly, and one that the Committee should take seriously: "Very large earthquakes **will** occur in Oregon's future, and our state's infrastructure **will** remain poorly prepared to meet the threat unless

we **take action now** to start building the necessary resilience." I hope today's hearing is the beginning of serious, thoughtful, and robust action by the federal government on earthquake preparedness and resilience.

Thank you.

STATEMENT

OF

ROBERT J. FENTON
DEPUTY ASSOCIATE ADMINISTRATOR
OFFICE OF RESPONSE AND RECOVERY
FEDERAL EMERGENCY MANAGEMENT AGENCY
U.S. DEPARTMENT OF HOMELAND SECURITY

BEFORE
THE

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON ECONOMIC DEVELOPMENT, PUBLIC BUILDINGS, AND EMERGENCY MANAGEMENT
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

PACIFIC NORTHWEST SEISMIC HAZARDS:
PLANNING AND PREPARING FOR THE NEXT DISASTER

Submitted
By

Federal Emergency Management Agency
500 C Street, S.W.
Washington, D.C. 20472

May 19, 2015

Introduction

Chairman Barletta, Ranking Member Carson, and Members of this distinguished Subcommittee, I am Robert J. Fenton, Deputy Associate Administrator of the Office of Response and Recovery at the Department of Homeland Security's (DHS) Federal Emergency Management Agency (FEMA). It is my pleasure to be here today to discuss FEMA's efforts within the realm of earthquake preparedness, response, and recovery.

As a fifth generation San Franciscan—who served for 13 years in FEMA's Region IX Office in Oakland and will soon be reporting as the Regional Administrator—I understand the significant threats that catastrophic earthquakes pose to our Nation. We have also recently seen the devastating consequences of the recent earthquakes in Nepal, and our thoughts continue to be with the survivors.

A catastrophic earthquake of that magnitude in an urban area of the United States would impact millions of people and cause profound social and economic impacts. The Federal government must maintain a forward-leaning posture and be ready to act decisively at the direction of the President to effectively support state, local, tribal and territorial governments in saving lives and protecting property. We are one part of a whole community effort that will be required to respond to and recover from such an event.

I appreciate the opportunity today to update you on FEMA and our whole community partners' efforts to improve our Nation's preparedness for earthquake threats and to maintain our readiness to respond. In my testimony today, I will highlight the progress we have made in identifying our highest earthquake risks across the country and developing deliberate plans that outline how the Federal government will support state, local, tribal, and territorial efforts in responding to these threats. I will also highlight how we are exercising our collective ability to execute these plans and incorporating lessons learned.

Catastrophic Preparedness and Planning Efforts

In 2011, the President directed the development of a new National Preparedness System (NPS) that includes a National Planning Framework for each of five mission areas—prevention, protection, mitigation, response, and recovery. These Frameworks identify how the whole community will build and deliver the core capabilities required to address the threats that pose the greatest risks to our Nation. The President also directed the development of a Federal

Interagency Operational Plan (FIOP) to support each of these Frameworks and to describe how the Federal government will execute its responsibilities in support of state, local, tribal, and territorial efforts.

The FIOP for Response is an all-hazards plan based on a "maximum of maximums" scenario that includes multiple catastrophic incidents and cascading impacts, including a major earthquake, a major land-falling hurricane, or a nuclear incident. Such a scenario would occur over a large geographic area, affect millions of people, and require response and recovery capabilities from across the whole community to include government at all levels, public and private sector resources, non-governmental organizations, and individual citizens. The concepts and tasks outlined in the FIOP for Response are scalable, flexible, and adaptable and can be used regardless of cause, size, location, or complexity of incidents.

In addition to this national-level planning, FEMA and our partners also conduct regional catastrophic planning efforts to address threats with the greatest likelihoods of occurrence based on location. These plans focus on the immediate delivery of resources to meet life-saving and life-sustaining needs, with a goal of stabilizing an event within the first 72 hours. During the past two years, Regional All-Hazards response plans have been completed in all ten FEMA Regions in synchronization with the single FIOP for Response. Many of our Regions face significant earthquake threats, and I would like to highlight a number of significant planning activities we have undertaken to address those risks.

- To address threats posted by the 800-mile-long Cascadia Subduction Zone in the Pacific Northwest—and the tsunami that may occur from a catastrophic earthquake in that area—FEMA Regions IX, X, and the states of Washington, Oregon, California, Alaska, and Idaho, along with British Columbia, Canada, developed joint catastrophic earthquake and tsunami plans that represent capabilities from all levels of government, the private sector, and nonprofit organizations. These plans are the result of a collaborative process between hundreds of emergency management professionals who have also helped foster critical-public private partnerships.
- To address risks posed by the San Andreas Fault, FEMA Region IX worked with the State of California to develop the Southern California Catastrophic Earthquake Response Plan, to address a potential rupture on the southern fault.

- FEMA and our partners have also conducted extensive analysis and planning related to the New Madrid Seismic Zone in the central United States. FEMA Regions IV, V, VI, VII, and the states of Alabama, Mississippi, Tennessee, Kentucky, Indiana, Illinois, Missouri, and Arkansas developed joint plans to address the impacts from a catastrophic earthquake affecting communities across eight States. We tested these plans through the National Level Exercise in 2011.
- FEMA Region VIII and the State of Utah developed a joint catastrophic earthquake plan to address the impacts of an earthquake along the Wasatch Fault.
- Finally, FEMA and our partners are preparing and planning for potential tsunamis that may occur as a result of catastrophic earthquakes in areas in addition to the pacific coast. We created catastrophic earthquake and tsunami plans in coordination with Hawaii, Puerto Rico, Guam, and the U.S. Virgin Islands

Exercising our Capabilities and Incorporating Lessons

2014 Capstone Exercise

Another critical element of the National Preparedness System is exercising the plans we develop. FEMA's National Exercise Program (NEP) is the principal exercise mechanism for examining national preparedness and measuring readiness. The NEP serves as the cornerstone of a collective effort to test, improve, and assess national preparedness across the homeland security enterprise. Resilience is enhanced across the whole community through the design, development, conduct, and evaluation of a progressive cycle of exercises that tests the ability to prevent, protect, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk.

As such, the 2014 Capstone Exercise engaged a whole community approach to examine our Nation's ability to respond to and recover from a catastrophic incident using the National Preparedness Frameworks, FIOPs, and other applicable plans. The exercise used a scenario involving multiple threats, including an earthquake, tsunami, and a nuclear accident. Using a common scenario and sequence of events, the exercise integrated and unified five National Exercise Program events:

1. **Alaska Shield** – Provided the core framework for the 2014 exercise and commemorated the anniversary of the 1964 9.2-magnitude Great Alaskan Earthquake by replicating the earthquake's effects and resulting tsunami;
2. **Ardent Sentry** – Aligned key U.S. Department of Defense components with

Alaska Shield, focusing on the Defense Support of Civil Authorities mission;

3. **Nuclear Weapon Accident/Incident Exercise** – Involved the exercise scenario of a nuclear accident occurring during a secure transportation convoy of nuclear weapons within the continental United States;
4. **Eagle Horizon** – Tested the Nation's ability to conduct continuity of operations and reconstitution plans; and
5. **Silver Phoenix** – Examined the full range of efforts required to support the recovery from an earthquake, tsunami, and nuclear weapons accident.

The 2014 Capstone Exercise included nearly 10,000 emergency management and homeland security participants from local communities, states, tribes, private sector organizations, and over fifty State and Federal departments and agencies. The exercise revealed many strengths, including successful sharing of geospatial information; the use of alternate public messaging strategies to reach audiences without communications and power; and the integration of mitigation efforts into response operations.

In addition to identifying many of the whole community's strengths, the exercise also identified a number of key areas for improvement, including mission assignment and resource-request processes; processes and systems to create one accurate National common operating picture across local, state, regional, tribal, and federal partners, particularly with regard to movement of assets; and sufficient organizational structure for integrating recovery efforts into response operations.

Since the Capstone, FEMA has been working with our partners to address these lessons learned. For example, we have taken steps to ensure that all Mission Assignments required to support the first 72 hours of a response, as identified in our deliberate plans, are issued within the first three hours of an event. To further expedite our response, we are working to bolster our Pre-Scripted Mission Assignment (PSMA) program, including posting PSMAs and the execution schedules they support to our crisis management system so they can be immediately tailored based on initial incident assessments. In 2015, we also updated the Mission Assignment Guide to ensure our processes are clearly defined and understood by our response and recovery staff and our partners.

FEMA has reformed our Incident Management Assistance Team (IMAT) program to better integrate capabilities required for both the response to and recovery from a catastrophic disaster. Today, our IMATs at both National and Regional levels better represent the core capabilities required by the National Response and Recovery Frameworks and include personnel who are accountable for coordinating the Federal response and recovery regardless of type of incident. The personnel on these teams train together through an intensive, twelve-week long academy and—to graduate from the academy—they must succeed together in high-stress exercise environments.

2015 Southern California (SoCal) Earthquake Exercise

FEMA most recently participated in the Southern California Earthquake Exercise (SoCal 15), which took place concurrently with both USNORTHCOM's 2015 Ardent Sentry exercise and the California Capstone exercise. The exercise scenario was similar to the 2008 Great Southern California Shakeout, involving a magnitude 7.8 earthquake on the San Andreas Fault in southern California. Participants in this exercise included the State of California, the Department of Defense, and a number of FEMA components, including the National Response Coordination Center, the Region IX Response Coordination Center, the FEMA Operations Center, and a National IMAT.

The purpose of FEMA's participation was to assess regional and national incident management and incident support capabilities to the State of California following a catastrophic earthquake in a major metropolitan area. FEMA's overarching objectives were to test our ability to integrate into whole community incident management and incident support structures; to collaborate with the whole community to address economic, social, political, geographic, legal, regulatory, policy, and other issues related to fostering the stabilization and recovery of affected communities; and to collect and analyze information collaboratively to promote effective data-driven decision-making.

Additionally, our overarching exercise objectives sought to test execution of the core capabilities within the National Response and Recovery Frameworks and supporting plans, including the core capabilities of Planning, Operational Coordination, Public and Private Services and Resources, Situational Assessment, Critical Transportation, and Mass Care Services. Together with our partners, we are currently analyzing the results of the exercise and will integrate lessons learned into our plans, doctrine, and operations as required.

Promoting Individual Preparedness

In addition to the planning and exercising that FEMA supports with our whole community partners, I also want to highlight an important initiative through which we are working to improve individuals' preparedness for earthquake hazards.

America's PrepareAthon! and the Great Shakeout

In September 2013, FEMA and our partners unveiled America's PrepareAthon! – a nationwide community-based campaign for action to increase emergency preparedness and resilience. The goals of the campaign are to encourage individuals to understand what type of disasters are most likely in their own communities, to know what to do to be safe and mitigate damage, to take action to increase preparedness, and to participate in community planning. Twice a year, the campaign brings together individuals, organizations, and communities to practice responding to local hazards to strengthen their ability to deal with future emergencies.

ShakeOut is a major activity of America's PrepareAthon! As part of the campaign, 18.8 million individuals participated in earthquake drills in 2013 for the one-day Great ShakeOut – Drop, Cover, and Hold on. In 2014, the number of participants rose by nearly 45 percent with approximately 27 million people participating. And this year, approximately 6 million people have already registered to participate in the Shakeout slated for October.

Every Second Counts: Earthquake Warning and Detection

FEMA made significant strides in alert and warning systems through our Integrated Public Alert and Warning System (IPAWS) for All Hazards. In addition, I would like to highlight that FEMA routinely coordinates with our Federal partners including the United States Geological Survey (USGS) on earthquake early warning (EEW) systems to alert devices and people of potential earthquake activity – for example supporting USGS's ShakeAlert – a demonstration EEW system currently under development that is designed to cover the West Coast States of California, Oregon, and Washington.

In short, FEMA is committed to working with states such as California and Oregon and our federal interagency partners because we understand early detection for earthquakes is a key factor to life safety and sustainment.

Conclusion

Finally, I hope what is apparent throughout my testimony today is that FEMA is one part of a whole community effort that is required to effectively prepare for, respond to, and recover from catastrophic disasters. The response to a major earthquake along one of our Nation's fault lines will require resources from across all levels of government, the private sector, non-governmental organizations, and the public. These are the scenarios that we are planning and exercising against, and we are adapting the way we do business based on lessons learned. I look forward to working with you, distinguished Members of this Subcommittee, and other Members of Congress to continue these important efforts. I am prepared to answer any questions the Subcommittee may have.

Question#:	1
Topic:	Earthquake Early Warning Systems
Hearing:	Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster
Primary:	The Honorable Lou Barletta
Committee:	TRANSPORTATION (HOUSE)

Question: Some private developers have installed building specific earthquake early warning systems in individual buildings that can be networked with other private buildings. Has FEMA evaluated these situations to determine whether such systems are feasible for State or tribal government buildings or private nonprofit facilities and if such building specific systems should be eligible for mitigation funding?

Response: FEMA has been closely monitoring the development of Earthquake Early Warning (EEW) at both the headquarters level as part of its implementation role in the National Earthquake Hazards Reduction Program (NEHRP) and at the regional level since EEW has also been funded by the State of California.

According to the U.S. Geological Survey (USGS), EEW systems use seismic monitoring systems to alert devices and people when shaking waves generated by an earthquake are expected to arrive at their location. Specifically, seismic monitoring systems detect the initial earthquake wave (the P-Wave) and using that information, send out an electronic signal (which travels faster than the earthquake shaking S-Waves) to provide seconds of warning time, which can allow people and systems enough time to take protective actions. While EEW can be very beneficial in many situations, there are some situations where it is not. First, if an EEW system is located close to the epicenter, the earthquake shaking may arrive before the signal does, especially if the seismic network is not dense enough to provide immediate detection (which is the case for most of the country). Second, EEW is not a replacement for having a safe, code-compliant building. Receiving an EEW signal does little good in the event of a building collapse.

Since 2006, the USGS has been working to develop EEW for the U.S., with the help of several cooperating organizations including the California Geological Survey (CGS), the California Institute of Technology (Caltech), the California Office of Emergency Services (CalOES), the Moore Foundation, the University of California-Berkeley, the University of Washington, and the University of Oregon. A demonstration EEW system called ShakeAlert began sending test notifications to selected users in California in January 2012. The system detects earthquakes using the California Integrated Seismic Network (CISN), an existing network of about 400 ground motion sensors. CISN is a partnership between the USGS, State of California, Caltech, and University of California, Berkeley. Furthermore, the ShakeAlert earthquake early warning system uses both the California Integrated Seismic Network and the Pacific Northwest Seismic Network. There are currently 760 seismic stations contributing to the ShakeAlert systems in the states of California, Washington, and Oregon.

Question#:	1
Topic:	Earthquake Early Warning Systems
Hearing:	Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster
Primary:	The Honorable Lou Barletta
Committee:	TRANSPORTATION (HOUSE)

In February 2016, the USGS, along with its partners, rolled-out the next-generation ShakeAlert early warning test system in California. This system will not yet support public warnings but will allow selected early adopters to develop and deploy pilot implementations that take protective actions triggered by the ShakeAlert warnings in areas with sufficient coverage. The USGS has published an implementation plan with the steps needed to complete the system and begin issuing public alerts.

Question#:	2
Topic:	Buildings Built or Repaired with FEMA Funds
Hearing:	Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster
Primary:	The Honorable Lou Barletta
Committee:	TRANSPORTATION (HOUSE)

Question: Right now, when buildings are built or repaired with FEMA funds, they are rebuilt to State and local building codes. Are there barriers that would prohibit FEMA from requiring any buildings repaired or replaced with FEMA's federal funds to meet the latest seismic building standards?

Response: All new construction and repair work (when triggered) using FEMA funds must comply with all applicable State and local building codes. In addition, FEMA's Public Assistance Program has recently released a new policy on required minimum standards (FEMA Recovery Policy FP-104-009-4) that, for the first time, goes beyond that requirement and establishes minimum standards for Public Assistance building projects to promote resiliency and increased achieved risk reduction under the authority of the Stafford Act § 323, 42 U.S.C. § 5165a and § 406(e), 42 U.S.C. § 5172. Specific details of the policy include:

- When using Public Assistance funding to repair, replace, or construct buildings in hazard-prone areas, applicants will use, at a minimum, the hazard-resistant design standards referenced in the International Code Council's (ICC) *International Building Code* (IBC), *International Existing Building Code* (IEBC), or *International Residential Code* (IRC).

- The policy applies when a building is: Substantially Damaged, suffers Substantial Structural Damage, and/or eligible for replacement.

- The determination of whether a standard is triggered will be made by the appropriate building official or inspector, where applicable, or by the recipient's or sub-recipient's registered design professional or other appropriate and qualified individual.

- Costs associated with implementing these standards are eligible for Public Assistance funding at the cost-share for the disaster.

- These standards must apply to the type of repair or restoration required, be appropriate to the pre-disaster use of the facility, and be reasonable.

- FEMA will determine the eligibility of the costs to comply with local standards that require a stricter hazard-resistant upgrade based on the eligibility criteria found in 44 CFR part 206.226(d).

Question#:	2
Topic:	Buildings Built or Repaired with FEMA Funds
Hearing:	Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster
Primary:	The Honorable Lou Barletta
Committee:	TRANSPORTATION (HOUSE)

- Upon completion of a project the sub-recipient must provide proof of compliance.
- Funding for capped projects will be based on the estimated amount to restore the building to its pre-disaster design and function and any codes or standards, including the IBC, IEBC, and IRC.
- Eligible building projects involving substantial improvement or new construction in flood hazard areas must meet the minimization standards as described in 44 CFR § 9.11(d), or the IBC, IEBC, or IRC, whichever is higher.
- Upgrades to meet the IBC, IEBC, or IRC codes will be treated in the same manner as locally adopted codes and standards for the purposes of calculating repair and replacement costs.

Question#:	3
Topic:	Information Collection
Hearing:	Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster
Primary:	The Honorable Lou Barletta
Committee:	TRANSPORTATION (HOUSE)

Question: To what extent does FEMA collect and report information on local and national earthquake preparedness capabilities to identify potential preparedness shortfalls or gaps?

Response: The National Preparedness System and the related National Preparedness Goal (the Goal) serve as the framework for assessing preparedness for all hazards, including earthquakes. The Goal defines a set of 32 core capabilities needed to achieve national preparedness across the 5 mission areas (Prevention, Protection, Mitigation, Response and Recovery), and includes measurable objectives for managing risk. The National Preparedness System provides a systematic approach to meeting the Goal that builds on communities' proven preparedness activities. This capabilities-based approach allows communities to develop the resources needed to address all hazards, rather than focusing on resources needs for specific threats and hazards. Through the NPS, FEMA has helped states to establish goals and objectives that will enable states to identify preparedness gaps and measure improvements in first responder capabilities and statewide preparedness.

Key to this approach are the Threat and Hazard Identification and Risk Assessment (THIRA) and State Preparedness Report (SPR). In the Second Edition of the *Comprehensive Preparedness Guide 201: Threat and Hazard Identification and Risk Assessment (THIRA) Guide (CPG-201)* FEMA describes a standard process for identifying community-specific threats and hazards and setting capability targets for each core capability identified in the Goal. The THIRA process assists communities in answering questions such as, "What are my current and future risks?" and, "What levels of service do I need to address my risks?", and it addresses specific capability needs, such as teams of specialized resources. Once each jurisdiction has determined capability targets through the THIRA process, the jurisdiction assesses its current capability levels against those targets through the State Preparedness Report (SPR). FEMA reports the results of the capability assessments annually in the *National Preparedness Report* (NPR).

In 2015, twenty-seven States and Territories identified earthquake as a hazard of concern through the THIRA process. This attention to earthquakes is reflected in multiple state and regional exercises. Specifically, in June 2016 FEMA Region X, along with many other government sponsors, held a four day "Cascadia Rising" exercise to address a 9.0 magnitude earthquake along the Cascadia Subduction Zone (CSZ) and the resulting tsunami. The exercise marked an unprecedented level of Emergency Operation Center activation and coordination in the Pacific Northwest emergency management community.

Question#:	3
Topic:	Information Collection
Hearing:	Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster
Primary:	The Honorable Lou Barletta
Committee:	TRANSPORTATION (HOUSE)

Lessons learned from this exercise will shape planning, training and capability development across the Region.

The FEMA focus on improving preparedness for earthquakes includes both annual and targeted surveys to assess earthquake preparedness and regular review of the scientific basis for the protective actions for earthquake to ensure that the FEMA guidance to the public is relevant, effective and actionable. For example, FEMA is one of four primary agencies supporting the National Earthquake Hazards Reduction Program (NEHRP), which is the Federal government's coordinated long-term nationwide program to reduce risks to life and property in the United States that result from earthquakes. The NEHRP has modeled earthquake scenarios for multiple ShakeOut™ exercises, and has published this information to enhance risk communication and preparedness among the public.

Additionally, FEMA conducts an annual National Household Survey to understand and assess preparedness attitudes, and behaviors. For the past four years, the survey has included assessments for multiple specific hazards including the natural hazards of earthquake, tornado, flood, wildfire, winter storm and extreme heat.

To ensure that FEMA preparedness guidance consistently reflects current research, FEMA has worked with interagency and academic research community to identify and review the research for more than 380 protective actions for 12 natural hazards including protective actions for earthquake. This work with research and practitioner partners has led to improvements in messaging on the key protective action of "Drop, Cover, and Hold On," and to improved communication of earthquake risk using hazard maps that include locations with a predicted level of shaking that would benefit from simple steps to secure nonstructural items as well as structural mitigation to reduce death and injuries.

Dr. Scott A. Ashford
Dean, College of Engineering
Oregon State University
Corvallis, OR

Testimony
United States House of Representatives
Committee for Transportation and Infrastructure
Subcommittee on Economic Development, Public Buildings, and Emergency Management

"Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster"

May 19, 2015

Good morning Mr. Chairman and Members of the Committee. My name is Scott Ashford, Dean of the College of Engineering at Oregon State University. I am pleased to be before you today, testifying on my role as Chair of the Governor's Task Force on Resilience Plan Implementation. In my role as task force chair, I was responsible for advancing the state of Oregon on a path towards resilience in the face of the upcoming mega-quake along the Cascadia Subduction Zone, perhaps the greatest impending natural disaster in the United States of America.

I have a Ph.D. in geotechnical engineering and my expertise is in earthquake engineering. I have seen firsthand communities destroyed by earthquakes from my participation on post-earthquake reconnaissance teams, many funded by the National Science Foundation. In the magnitude 8.8 2010 Chile earthquake, I was struck how the 500,000 residents of Concepcion were cut off from help from the southern half of the country because ALL of the bridges over the river through the city had failed. In 2013, I was shocked to see the Central Business District in Christchurch, New Zealand, fenced off and virtually abandoned still two years after a sequence of magnitude 6 and 7 earthquakes. And in Japan, I saw the devastation left by the 2011 earthquake and tsunami that killed over 15,000 people and wiped entire communities off the map. This magnitude 9.0 subduction earthquake is the mirror image of what we expect in Northwest from the Cascadia Subduction Zone.

While the damage I observed in Chile, New Zealand, and Japan was overwhelming, the destruction could have been much worse. All of these countries are known for their earthquake risk. Much of their infrastructure was built for seismic resilience, and the people have the experienced the necessary earthquake response. All these countries are better prepared than we are as a state, region, and country for the unique threat of the Cascadia Subduction Zone.

The Cascadia Subduction Zone extends from British Columbia to northern California. It separates the Juan de Fuca and North American Plates. Numerous studies, including research conducted by scientists at Oregon State, indicate that the question is not if but

when a major earthquake will occur. The body of research establishes likelihood for a 9.0 magnitude earthquake, with strong shaking lasting three to five minutes, and a tsunami inundating much of the coastline. Furthermore, according to research conducted by Oregon State researchers, and published by the U.S. Geological Survey, by the year 2060, if we have not had a significant earthquake, we will have exceeded 85 percent of all known intervals between major occurrences over the past 10,000 years.

However, in Oregon, the historical intervals between major seismic events in the Cascadia Subduction Zone are much less frequent than in countries like Chile or Japan, where the more common experience with a major seismic event has in many ways forced them to adopt a culture of preparedness. Comparatively, in the Northwest, a major earthquake has not occurred since the year 1700. There is no structure standing today that withstood that earthquake. We have no practical experience with the major earthquakes or tsunamis which historical trends lead us to expect to occur this century.

The biggest challenge for Oregon is our legacy infrastructure — vulnerable buildings, bridges, pipelines, electrical substations — that were built before anyone was aware that the Cascadia Subduction Zone was active. This problem is not unique. Arkansas and Kentucky, states in the New Madrid fault zone, are also seismically vulnerable because of their legacy infrastructure.

In 2011, Oregon leaders recognized the need to prepare for the eventual likelihood of a major seismic event and called for a statewide plan. The Oregon Resilience Plan was completed in 2013, which can be accessed here:

http://www.oregon.gov/OMD/OEM/osspac/docs/Oregon_Resilience_Plan_Final.pdf

This landmark report to the Oregon Legislature was the result of the volunteer work of over 150 professionals from the business community, government agencies, and academia. The Plan assessed where Oregon is today, and laid out priorities to allow the people of Oregon to survive and bounce back from the expected magnitude 9.0 Cascadia earthquake and tsunami. Our vision is that 50 years from now, our people, businesses, infrastructure, and communities will have the resilience to recover from this mega-quake. The 300-page report contains over 140 different recommendations. And frankly, it was difficult to figure out where to start its implementation.

To find a path forward, the Legislature formed the Governor's Task Force on Resilience Plan Implementation later in 2013. As chair, my mission was to work with the task force to determine the most important first steps that the State could achieve in the next two years. Our specific recommendations, covering eight areas, were submitted to the Legislature in September 2014 in a two-page report, which I have submitted as part of my testimony.

I would like to focus today on just three where the federal government plays a key role in working in partnership with the state and private enterprise to achieve our earthquake and tsunami preparation and mitigation objectives.

1) Transportation

Mobility is critical to rescue, relief, and recovery efforts following a natural disaster; and for the economy to start moving so people can get back to work. Reports from the Oregon Department of Transportation indicate that following a magnitude 9.0 Cascadia Subduction Zone earthquake, all of U.S. Highway 101 along the West Coast would be shut down, all routes to the coast would be shut down, and only parts of Interstate 5 would be open. This is a life-safety issue for those who will have survived the earthquake and tsunami, but are increasingly compromised because they are cut off from help and cannot be rescued. Our task force recommended that the state find a way to fund the first phase of a comprehensive seismic retrofit program for Oregon's major access highways. The "Oregon Highways Seismic Plus Report" can be found here:

http://www.oregon.gov/ODOT/HWY/BRIDGE/docs/2014_Seismic_Plus_Report.pdf

The entire seismic retrofit program is over $5 billion, and is overwhelming for a state the size of Oregon. The first phase price tag to strengthen bridges and prevent landslides only along a lifeline backbone route is $1 billion alone. This is definitely an area where enhanced state-federal partnership is needed, where the state is stuck with a plan but no money to act.

2) Liquid Fuels:

Ninety percent of all liquid fuel used in Oregon comes into the state through pipelines that cross the Columbia River and land northwest of Portland at a site highly vulnerable to liquefaction and lateral spreading in a Cascadia earthquake. Due to the interstate nature of the liquid fuel transmission, Oregon has no regulatory authority. Rather than take this on, our task force recommended the state pursue a public-private partnership to develop an alternative source of liquid fuel. This is an area where the federal government can work with affected states to require seismic resilience of federally regulated utilities.

3) Research:

I am a professor, and this may sound self-serving, but our task force recommended support of earthquake research. The key here is that businesses, public utilities, homeowners, and the state are facing several billion dollars of investment to improve resilience. With the unique combination of a mega-quake and legacy infrastructure, applied research is the way that we can assure that precious tax-payers dollars are used in the most value- and cost-informed manner possible.

Businesses already understand this. Companies like Portland General Electric and Northwest Natural Gas have joined the Bonneville Power Administration, the Port of Portland, and the Oregon Department of Transportation to form the Cascadia Lifelines Program at Oregon State University. These lifeline providers pool and direct their research dollars towards finding solutions to the seismic challenges they jointly face.

The Oregon Legislature also understands the need to act. In response to the Task Force recommendations for next steps to improve resilience, 18 related bills were submitted for

consideration during the current legislative session. Four legislative proposals have made it to the Ways and Means Committee where they sit today. These include our most important recommendation, the appointment of a Resilience Policy Advisor to the Governor, as well as tsunami preparedness legislation. Passage of these bills in the Oregon Legislature is a critical first step towards building resilience.

State and private resources alone, however, are not enough to address the scope and scale of what's needed to improve resilience in Oregon and throughout the Pacific Northwest, as well as in other regions across the country vulnerable to natural disasters. The federal government must also be an active partner. Key legislative opportunities this Congress that would facilitate effective public-private partnership for applied research are:

- The Highway Bill: University Transportation Centers can support seismic research.
- Reauthorization of the National Earthquake Hazards Reduction Program.
- Supporting seismic research funded by the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), U.S. Geological Survey (USGS), and the Federal Highway Administration (FHWA)

In closing, the Cascadia Subduction Zone is estimated to be the single greatest natural threat to the United States. Oregon is taking steps on its own to mitigate this threat. Other West Coast states and those in the New Madrid Fault Zone, including Arkansas and Kentucky, can follow our example. It will take decades and significant resources to improve our resilience, but we need to start now and we need to all work collaboratively across governments, academia, and the private sector. The federal government is a critical partner in our ability as a state, a region, and a country to effectively prepare for this impending natural disaster.

Thank you, Mr. Chairman and Committee Members, for the opportunity to appear before you today. I stand ready to answer any questions you might have.

Attachments

(1) Cover Letter to Governor's Task Force on Resilience Plan Implementation Report

(2) Governor's Task Force on Resilience Plan Implementation Report

Date: September 30, 2014

TO: The Honorable Members of the Oregon State Legislature

FROM: Scott Ashford, Chair, Governor's Task Force on Resilience Plan Implementation

The Governor's Task Force on Resilience Plan Implementation (ORTF) is pleased to submit this report on Resilience Plan Implementation Recommendations.

In accordance with SB 33, this report presents the Governor's Task Force on Resilience Plan Implementation recommendations on priority actions for seismic resilience. The Oregon Resilience Plan (ORP), completed in February 2013, presented more than 140 recommendations aimed at reducing risk and improving recovery for the next Cascadia earthquake. The ORTF studied these and other recommendations, including those specified in SB 33, and brought forward the most critical to be implemented in the 2015-17 biennium.

As was stated in the ORP's central finding, "Very large earthquakes will occur in Oregon's future, and our state's infrastructure will remain poorly prepared to meet the threat unless we take action now to start building the necessary resilience." The ORTF strongly concurs with that assessment, and with the need to commit tangible resources toward a common goal.

The charge was to address ORP *implementation* to encourage a sustained commitment over an extended period of time. That commitment includes capital expenditures toward our built environment, changes in some of our rules and strategies in how we develop our communities, and a greater effort toward restoring a resilient culture in our state. Our highest priority, however, is sustained leadership in this process. Only with continued oversight, engagement, and stewardship can we make substantial progress toward a more resilient Oregon.

This report can be found online at http://www.oregon.gov/OMD/OEM/Pages/Resilience-Taskforce.aspx

Task Force Members:

Scott A. Ashford, Chair	Oregon State University (Scientific Community Rep.)
Jeff N. Rubin, Vice-Chair	Tualatin Valley Fire and Rescue (SDAO Rep.)
Senator Arnie Roblan	SD 5, Oregon State Legislature
Senator Alan Olsen	SD 20, Oregon State Legislature
Rep. Debbie Boone	HD 32, Oregon State Legislature
Rep. Jim Weidner	HD 24, Oregon State Legislature
Heidi Moawad	Public Safety Policy Advisor to Governor Kitzhaber
Greg Wolf/Mark Ellsworth	Regional Solutions Director for Governor Kitzhaber
Commissioner Mark Labhart	Tillamook County Commission (AOC Rep.)
Mayor George Endicott	City of Redmond (LOC Rep.)
Jeff Soulages	Intel Corporation (Private Business Rep.)
Paula Negele	American Red Cross (Private Nonprofit Rep.)
Dave Ferre	Oregon Military Department
Dave Stuckey	Office of Emergency Management

Jay Wilson	OSSPAC Chair
Lucinda "Luci" Moore	Oregon Department of Transportation
Mike Harryman	Oregon Health Authority

Senate Bill 33
Implementation of the Oregon Resilience Plan

Report to the 77th Legislative Assembly dated October 1, 2014
From the Governor's Task Force on Resilience Plan Implementation

In accordance with Senate Bill 33, this report presents the Governor's Task Force on Resilience Plan Implementation (ORTF) recommendations on implementation of the Oregon Resilience Plan (ORP). The ORP, dated February 2013, presented more than 140 recommendations aimed at reducing risk and improving recovery for the next Cascadia earthquake. The ORTF studied these and other recommendations, including those specified in SB 33, and brought forward the most critical to be implemented in the 2015-17 biennium. For the eight categories listed below, we recommend:

A. Oversight
1. The State establish a Resilience Policy Advisor to the Governor. This requires a specific appointment, with defined responsibilities. We recommend that this position be appointed by, and report directly to, the Governor. The ORTF considers it essential that the State establish ongoing, long-term, statewide resilience oversight; it is not sustainable, practical, or good government to attempt to establish resilience through a series of temporary, unfunded, volunteer committees.

B. Transportation
1. Additional revenue be identified to complete the most critical backbone routes identified in ODOT's Seismic Options Report within a decade, and the complete program by 2060. The funding source should be ongoing and pay as you go, rather than financed through bonding, to provide resources for all phases over the course of several decades. Research would be incorporated into the program to ensure the most current technology and efficient methods are applied.
2. The State conduct a thorough inventory and assessment of transit, air and marine port, and rail assets.

C. Land Use
1. Per the process defined in OAR 632-005, the DOGAMI Governing Board adopt the "L" line from the most recent tsunami hazard maps, redefining the inundation zone for construction as defined in ORS 455.446 and 455.447.
2. In advance of formal statewide adoption as described in the preceding item, local governments adopt the latest version of tsunami hazard maps and analyses in comprehensive plan policies and development code regulations.
3. New funding of $5 million be made available by the State through existing programs for resilience planning by the coastal communities most at risk of severe impacts from a tsunami.
4. The Urban Reserve Rules (OAR 660-021) be revised to make them more useful for recovery planning prior to a tsunami.

D. Energy
1. The OPUC require energy providers it regulates conduct seismic assessments of its regulated facilities. Furthermore, we recommend the OPUC allow cost recovery for prudent investments related to assessments and mitigation of vulnerabilities identified during those assessments.
2. In order to further reduce vulnerability, the State establish a public-private partnership to mitigate and evaluate diversification of locations for storing liquid fuels, and identification of new liquid fuel energy corridors.

E. Critical Facilities and Seismic Rehabilitation Grant Program (SRGP)

1. DOGAMI be funded with up to $20 million to update and enhance the statewide inventory and provide preliminary evaluation of critical facilities.
2. The OBDD/IFA Seismic Rehabilitation Grant Program (SRGP) be funded with a minimum initial amount of $200 million in the next biennium, and that funding continue to the program in each subsequent biennium with a similar or higher level of funding.
3. As demolition costs for unsafe buildings can be prohibitive to local jurisdictions, "seismic rehabilitation" is defined to include demolishing unsafe (based on construction and/or location) structures: (ORS 455.020, 455.390, 455.395 and 455.400, OAR 123-051-0200).
4. Rules governing SRGP eligibility be modified to allow grant dollars to be used toward replacement facilities (as opposed to solely rehabilitation) for projects that must be moved out of a tsunami inundation zone.

F. Research

1. The State establish a research initiative that would provide $1 million annually for research aimed at improving Oregon's earthquake resilience. The initiative would be administered by DOGAMI and would provide 1:1 matching funds to the State's public universities for state-, federal- or industry-funded earthquake research.
2. A formal center of excellence for resiliency research and initiatives not be established.

G. Training and Education

1. Funding OEM at $500,000 to lead a process for the 2015-17 biennium, in partnership with key stakeholders, of developing and disseminating improved educational materials for agencies, businesses, and the public, including: a) Revising and standardizing information provided to the public and businesses to recommend an emergency preparedness goal of at least two weeks; b) Training and education specifically relating to disaster preparedness, response, recovery and mitigation for decision-makers in the public, private, and not-for-profit sectors; c) Supporting education, training, and related professional development for emergency managers, consistent with but beyond standard FEMA dissemination. This may include programs offered through institutions of higher education, conferences and other special events, and programs provided by professional associations; d) Establishing an electronic clearinghouse of educational and technical information for emergency responders and planners, technical specialists, workplaces, and the general public.
2. Funding the Department of Education at $500,000 for the 2015-17 biennium to lead a process of adopting standardized educational content and associated resources for K-12, applicable to the entire State as well as for specific hazard areas (e.g., coastal communities), and to establish an electronic clearinghouse for curriculum and supporting resources.
3. Business Oregon, in partnership with OEM, strongly encourages continuity assessment and planning for all businesses.

H. Water/Wastewater

1. Water providers complete a seismic risk assessment and mitigation plan as part of the existing requirement for periodic updates to water system master plans.
2. Wastewater agencies complete a seismic risk assessment and mitigation plan as part of periodic updates to facility plans.
3. Firefighting agencies, water providers, and emergency management agencies to establish joint standards for use in planning the firefighting response to a large seismic event.

This is the required two-page report to the legislature. This report can be found at:
http://www.oregon.gov/OMD/OEM/Pages/Resilience-Taskforce.aspx

Witness Testimony

Richard M Allen, Ph.D.
Director, Berkeley Seismological Laboratory;
Professor, Department of Earth and Planetary Sciences
University of California, Berkeley

Hearing on:
"Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster"

Before the U.S. House of Representatives Committee on Transportation and Infrastructure, Subcommittee on Economic Development, Public Buildings, and Emergency Management

May 19th, 2015

Chairman Barletta, Ranking Member Carson, Members of the Committee, thank you for the invitation to testify at this hearing about reducing the devastation in the inevitable next megathrust earthquake in the Pacific Northwest.

The Pacific Northwest must be ready for a magnitude 9 earthquake. The source is the Cascadia subduction zone that extends from northern California up into Oregon, Washington, and southern Canada. Recent magnitude 9 events around the world include the 2011 Tohoku-Oki earthquake in Japan and the 2004 Sumatra earthquake. These were responsible for tens and hundreds of thousands of lives lost. The last magnitude 9 in the Pacific Northwest was just over 300 years ago, and we are now in the period when we should expect the next megathrust event.

My name is Richard Allen and I am the Director of the UC Berkeley Seismological Laboratory and a Professor of Earth and Planetary Science. I am also one of the principle architects of the ShakeAlert earthquake early warning system, a new technology that we hope to roll out along the US west coast to reduce the impacts of the next big event. We would very much like to build this warning system *before* the next quake occurs. But to do that will require action from this legislature.

The ShakeAlert earthquake early warning project is a collaboration between the University of Washington, the University of Oregon, the University of California Berkeley, the California Institute of Technology, the US Geological Survey and several state agencies. In a close collaboration, we are now operating a demonstration earthquake early warning system that issues alerts to a group of test users for events throughout Washington, Oregon and California.

So what is earthquake early warning? By using networks of geophysical sensors distributed across the west coast we can rapidly detect the beginnings of an earthquake. ShakeAlert then estimates the size of the event and predicts the

shaking intensity that will follow. The warning time depends on distance from the initiation point. In the case of the Pacific Northwest, if a magnitude 9 starts at the southern end of the Cascadia subduction zone--as research suggests--Portland could receive three minutes of warning and Seattle as much as five minutes.

There are many things that can be done to reduce the impact of an earthquake with a few minutes of warning. One of my colleagues, Professor Doug Toomey at the University of Oregon, asked one of his local elementary school principles how long it would take to evacuate his 350-students from the school, built in 1926. His answer: one and a half minutes. His is just one of 1000 schools that a recent Oregon state survey concluded would collapse in a magnitude 9 earthquake.

Studies of the injuries caused in the 1994 Northridge earthquake show that more than 50% were caused by falling hazards: bookcases, ceiling tiles, lighting fixtures etc. If everyone gets a warning, and if everyone drops, takes cover and holds on, then we could reduce the number of earthquake injuries by 50%. The total estimated cost of just injuries in the Northridge earthquake was $2-3 billion. That was just a magnitude 6.7 earthquake. A magnitude 9 quake will release one thousand times more energy.

Other applications of early warning include automated response of transportation systems, isolation of hazardous machinery and chemicals along production lines, opening elevator doors at the nearest floor possibly preventing hundreds of people from being trapped, mobilizing emergency response teams so that vehicles are not trapped in firehouses, and alerting surgeons to remove the scalpel from inside patients before the shaking starts.

The existing west coast ShakeAlert demonstration system has proven the capabilities of this technology. In the recent magnitude 6 earthquake in Napa California, ShakeAlert issued a warning across the San Francisco Bay Area. The BART train system is one of our test users. Although this is only a demonstration system, it is of such value to the BART train system that they have already implemented an automated train-stopping system. It takes BART just 24 sec to bring a train at full speed to a stop thereby reducing the likelihood of derailment. During peak hours, at any point in time, they have between 40 and 45 trains running at full speed, each carrying about 1000 passengers.

Earthquake early warning is not a panacea for the earthquake problem in the Pacific Northwest. It will not prevent buildings from collapsing and we must continue to make progress improving our buildings so that they will not collapse. At the same time, ShakeAlert provides a new opportunity to further reduce the impacts of coming quakes.

So what will it take to build an earthquake early warning system for the US west coast? The US Geological Survey is the federal agency with the responsibility for issuing alerts. But there is also a critical role for the private sector. Their expertise

is needed to distribute the alerts broadly through cell-phone and internet providers, TV and radio. Building a public warning system will also create new business opportunities to provide specialized alerts for specific users, and the development of automated control systems. Already several alerting and communication companies--including start-ups--have joined the group of test users to explore business opportunities.

Building this system is not expensive. The US Geological Survey has developed an implementation plan for the US west coast: Washington, Oregon and California. This system could be operational in two years if the necessary funding is made available. The cost of operating the west-coast system is $16.5 million per year above what is currently spent on operating the geophysical networks. With an additional one-time capitol investment of $38 million, the system could be fully operational in just two years.

Last year Congress appropriated $5 million to begin the process of transitioning from a demonstration system to a public system - *thank you.* The US Geological Survey and west coast universities are now using those resources to improve the geophysical network infrastructure to make the current system faster and more robust. This is a great first step, but the full implementation plan needs to be funded if we are to have fast, accurate and robust warning for *everyone* along the US west coast.

In closing, the earthquake threat along the US west coast increases every day as the strain builds on our faults. It is not *if,* but *when* will the next earthquake strike, and we are due for an earthquake in many locations. Earthquake early warning is a new and important tool to have in our disaster preparedness kit. Japan has a warning system; Mexico has system. China, Taiwan, Turkey and Romania have systems. If there was an earthquake today, I believe we would build this warning system tomorrow. Lets not miss this opportunity, let's fund ShakeAlert now.

I would like to thank the committee for its time and consideration of this important issue.

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Statement of

John D. Hooper, P.E., S.E., F.SEI, F.ASCE

Senior Principal and Director of Earthquake Engineering
Magnusson Klemencic Associates
Seattle, WA

on behalf of the

American Society of Civil Engineers

before the

Subcommittee on Economic Development, Public Buildings
and Emergency Management
of the
Committee on Transportation and Infrastructure
U.S. House of Representatives

May 19, 2015

Chairman Barletta and distinguished members of the Subcommittee on Economic Development, Public Buildings, and Emergency Management, I am John Hooper, a Senior Principal and Director of Earthquake Engineering with Magnusson Klemencic Associates. On behalf of the American Society of Civil Engineers, it is my pleasure to provide this testimony to you regarding "Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster." My testimony will review the state of seismic design in the Pacific Northwest and address a key component needed to produce more resilient communities. As Senior Principal and Owner of a 200-person structural and civil engineering firm headquartered in seismically active Seattle for the last 95 years, and having witnessed firsthand the impact earthquakes can have on a community, this is a matter of great importance to me.

In addition to designing building structures throughout the West Coast, across the country, and around the world, I have also participated in structural building code development and earthquake engineering research for nearly 3 decades. I have served in various capacities for those efforts, and am currently the Chair of the American Society of Civil Engineer's ASCE 7 Seismic Subcommittee.

This subcommittee is tasked with developing the seismic requirements that the vast majority of state and local jurisdictions throughout the United States, as well as other countries, adopt for their seismic regulations. Jurisdictions adopt these seismic requirements by way of voluntarily adopting the International Building Code (IBC), a comprehensive code that sets coordinated and comprehensive requirements for building design and performance. The majority of state and local jurisdictions adopt the IBC to capitalize on the code's vast volume of compiled knowledge, then modify as appropriate based on their specific jurisdictional needs and priorities.

The IBC references "ASCE 7 Minimum Design Loads for Buildings and Other Structures" (ASCE 7) for the design requirements for most natural hazards, including seismic. ASCE 7 is developed by a consensus standards development process that has been accredited by the American National Standards Institute (ANSI) and provides the technical information necessary for use in design of buildings and other structures.

Development Background of Seismic Codes and Standards

Structural engineering of buildings is very technical and complex, and designing for locations with earthquake potential is even more advanced and specialized. To aid in your understanding of ASCE 7's recommendations today, I would like to briefly explain how current standards of seismic engineering have evolved.

Seismic design requirements have been enforced in the United States for over a century, with their origins in the 1906 San Francisco Earthquake. Since that seminal event, seismic design regulations have evolved extensively. Initially, seismic design requirements were developed through the voluntary efforts of structural engineers in California for use in their state in order to mitigate future losses from earthquakes. Over time, these requirements were adopted into the Uniform Building Code (UBC). The UBC, originally published in 1927, was the building code used by states and jurisdictions throughout the western United States, including the Pacific

Northwest. These efforts continued through the mid-1990s, when the UBC, along with other building codes, was consolidated into the IBC.

A major contribution to the evolution of seismic design was development by the National Earthquake Hazards Reduction Program's (NEHRP's) of the "NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" (or simply the NEHRP *Provisions*), originally published in 1985. These seismic design guidelines were developed voluntarily by engineers from around the country, with leadership and support from the Federal Emergency Management Agency (FEMA) as well as the Building Seismic Safety Council, which managed the overall effort. The NEHRP *Provisions* have been continually updated since that first version, with the next version due for publication the end of 2015. Over the last 3 decades, the *Provisions* have evolved into a widely available, trusted, state-of-the art seismic design resource document with requirements that have been adapted for use in the nation's model building codes and standards. The *Provisions* also serve as the resource document to the seismic design requirements currently found in ASCE 7. This collaboration between the NEHRP *Provisions* and ASCE 7 has been in existence for over 20 years.

Pacific Northwest Seismic Hazards

The Pacific Northwest is a fairly complicated seismic hazard region. Due in large part to the research led by the United States Geological Survey (USGS) for nearly 3 decades, the region's seismic hazards are much better understood today, including the hazard associated with the Cascadia Subduction Zone. The Cascadia Subduction Zone is a convergent plate boundary that stretches from northern Vancouver Island to northern California. It is a very long, sloping subduction-zone fault that separates the Juan de Fuca and North America plates.

The Cascadia Subduction Zone has produced numerous events of up to Magnitude M_W9 over the past thousands of years. However, the potential of an event on the Cascadia Subduction Zone was not fully understood until the USGS research findings of the late 1980s were presented to the structural engineering community in the Pacific Northwest. Based on this research, the seismic zone maps in the 1994 UBC were modified to include the effects of the Cascadia Subduction Zone. Research on the potential shaking hazard of the Cascadia Subduction Zone continues to be refined today, and there is still more to be learned.

Policymakers, emergency planners, and structural engineers in the Pacific Northwest are very aware of the shaking that can result from a Cascadia Subduction Zone event. I personally have been involved in numerous earthquake workshops and emergency planning exercises based on this event. The recent subduction zone earthquakes in Indonesia (2004), Chile (2010), and Japan (2011) have only heightened awareness. I made immediate follow-up visits to the site of the Chile event (as well as Loma Prieta and Northridge, California, 1989 and 1994, respectively; Kobe, Japan, 1995, Manzanillo, Mexico, 1995; and Taiwan, 1999) for the purpose of researching and analyzing building performance to share with the engineering community.

Due to continued publicity regarding new research findings, the public also appears to be genuinely aware of the Cascadia Subduction Zone's potential. However, it is fairly clear that the

public, and perhaps some policymakers and emergency planners, are not aware of the performance goals associated with the seismic design requirements found in ASCE 7.

Seismic Performance Goals

The vast majority of the public is also not aware of the seismic performance goals for buildings associated with the ASCE 7 seismic design requirements. The seismic performance goals for ordinary buildings, defined as "Risk Category II" structures in the building code, such as office buildings, hotels, retail shops, and residential buildings, are to protect life given "rare" earthquake ground shaking at a site and to achieve a uniform, low likelihood of building collapse given "very rare" earthquake ground shaking. Under those goals, damage to the point where it may not be economically feasible to repair a building is possible, if not probable. For critical and essential facilities, defined as "Risk Category III" and "Risk Category IV" structures in the building code, such as emergency operation centers, police and fire stations, and hospitals, the performance goals are enhanced relative to ordinary buildings, with the intent that these facilities will experience damage but be functional following "rare" earthquake ground shaking.

A "very rare" event represents earthquake ground shaking that has a recurrence interval of approximately 2,500 years (denoted in ASCE 7 as the "Risk-Targeted Maximum Considered Earthquake," or MCE_R). A "rare" event assumes earthquake ground shaking at 2/3 of that experienced during a "very rare event," with a recurrence interval ranging from 200 to 1,000 years depending on where the site is located (denoted in ASCE 7 as the "Design Earthquake" or DE).

Create More Resilient Communities through More Resilient Design

To provide more resilient designs, and therefore more resilient communities, a change is required in these seismic performance goals. This change will come with increased construction costs. Some federal, state, and local jurisdictions have provided, or are considering, enhanced performance for some of their projects. This enhanced performance will likely target performance similar to what is required for critical or essential facilities described previously. Some large companies that would be financially affected by an extended shut down have already invested in enhanced seismic design for their projects. Typically, though, private owners and developers are generally unaware of the expected performance of a "code-designed" building, with corresponding potential negative impacts, and the potential benefits an "enhanced" seismic design can bring to their project. The few owners and developers I have communicated with that do have a good understanding will typically only implement an enhanced design if they can achieve a reasonable return on their investment.

Policymakers are aware of these issues. Changing the design approach for an entire community to increase resiliency will be a challenge. First, the turnover of building stock in a typical community is low, so enhancing the performance of existing buildings will require seismic upgrading. However, it is not necessary that *all* buildings achieve enhanced performance to achieve a resilient community. Careful planning is needed to determine which buildings and facilities should be subject to enhanced seismic design or seismic upgrading. Second, and equally important, for a community to be resilient, the remainder of the community's lifelines

must also be seismically designed or upgraded to an enhanced performance level, including roads, bridges, water and sewer lines, power (electrical and gas) distribution systems, fiber optic lines, etc. Finally, given the need to provide enhanced seismic design for both buildings and lifelines to achieve a resilient community, the key element is to fund these capital costs. Regardless of these challenges, through policymaker leadership and careful community planning, the beginnings of resilient communities can...and increasingly will...be achieved.

Improve Building Performance by Embracing NEHRP Seismic Research

To continue to improve understanding of building performance from earthquake shaking, research funding is required. While great strides have been made over the past 30 years, there are still many technical problems to solve—especially finding better, more economical ways to provide enhanced seismic performance so that the goal of community resiliency can be better achieved.

As previously described, the National Earthquake Hazards Reduction Program has made significant contributions to seismic design requirements incorporated into today's codes and standards. The program has also provided vital contributions in both applied and basic research to help mitigate seismic risk and achieve community resilience. Last reauthorized by Public Law 108-360 in 2004, the program underwent the most significant changes in its history, with strong support from the earthquake risk-reduction community. However, authorization of the program expired in October 2009. One of the best things Congress can do to further the cause is to move swiftly to reauthorize the program.

Since being created by Congress in 1977, NEHRP has provided the resources and leadership that have led to significant advances in understanding the risk earthquakes pose and the best ways to counter them. Through NEHRP, the federal government has engaged in seismic monitoring, mapping, research, testing, engineering, and creation of related reference materials for building code development, risk mitigation, and emergency preparedness. NEHRP has served as the backbone for protecting U.S. citizens, their property, and the national economy from the devastating effects of large earthquakes. Although NEHRP is well known for its research programs, it is also the source for hundreds of new technologies, maps, design techniques, and guidelines that are used by design professionals every day to mitigate risks, save lives, protect property, and reduce adverse economic impacts.

NEHRP makes Americans safer and our nation more secure, resilient, and financially stronger through research in the earth and behavioral sciences, public policy, and engineering, followed by implementation of the findings. ASCE and I urge you to work with the Science, Space and Technology Committee to reauthorize this vital program.

Thank you for the opportunity to share my views regarding "Pacific Northwest Seismic Hazards: Planning and Preparing for the Next Disaster."

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